Subterranea

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In This Issue...

Subterranea Britannica www.subbrit.org.uk

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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Front cover photo: The BBC studio in the Jersey Civil Emergency Centre in Trinity Road St. Helier. Similarly equipped BBC studios were fitted in all RGHQ's during the 1980s. Equipment includes an Audix mixer, AKG D202 Microphone (Mic 1), UHER reel to reel portable tape recorder, Revox reel to reel studio tape recorder, Sony professional cassette recorder, Marantz cassette recorder, 2 Technics SP1200 record decks, Technics tuner, lip microphone, loudspeaker, clock and a floor standing 19" rack of line interface equipment; all incoming and outgoing audio lines pass through this unit. Photo Nick Catford

Back page upper: The coal bunkers beneath the car park of the Abbey Mills pumping station in East London. The coal bunkers held about one thousand tons of coal and were furnished with an elaborate system of tramways over which the coal was conveyed in small trucks to the various boilers. Due to ground instability and the deteriorating condition of the bunkers, all but two bays were infilled with foamed concrete in early 2012. Photo Nick Catford

Back page lower: The Sub Brit party line up in front of the Jersey War Tunnels (Ho 8) which housed the German underground hospital. Photo Dom Jackson

Newsletters of Subterranea Britannica are published by the committee of Subterranea Britannica. Original articles, book reviews, press cuttings, extracts from books and journals, letters to the Editor etc are welcome. However the Editor reserves the right not to publish material without giving a reason.

The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.

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Chairman's Welcome

Martin Dixon

Subterranea number 30 represents a great milestone in the magazine's history. At three editions per year (give or take the odd 'special') this means that our publication has been going for ten years. Created and edited for many years by the much missed Dan McKenzie, it has continued to grow and thrive in the hands of Nick Catford.

As well as the authors, without whom there would of course be no content, we all owe a debt of gratitude to the rest of the team. Linda Dixon oversees sub-editing (pun intended!), Stewart Wild does first-rate proofreading, Tim Robinson produces some splendid plans and Martin Snow handles the layout. And, of course, our friends at Hillary Press produce the end product. If ever you have an idea for a piece for *Subterranea*, please don't hesitate to send it in – whether it's a complete article or just a snippet of news.

Alongside this traditional communication channel, the social media team are busy growing our presence on Twitter and Facebook. Whilst accepting that these media are not for all, they do offer a great way to increase awareness of our underground heritage at a very low cost. We currently have over 1,500 followers/likes on the two channels and they form a great way to grow our membership too.

Speaking of membership, we are working to implement a new membership system that will allow members to update their own contact details and will reduce the workload for both our treasurer and membership secretary. In time the system will also be able to handle trips and event bookings and will act as the gateway for members to be able to make their own updates to the Sub Brit website.

For those who missed the AGM, the minutes appear elsewhere in *Subterranea*. Apart from the 'routine' business, we were able to publicly award Paul Sowan with Honorary Membership of Subterranea Britannica. This was agreed by the Committee in the light of Paul's long-term and ongoing contribution to underground research and publication, including over twenty-five years as Sub Brit's Chairman.

It was also good to see Sylvia Beamon, our founder, at the AGM and the day meeting that followed. We were especially pleased to see lots of new faces, without whom Sub Brit wouldn't be the lively and growing society that it is. I was recently at an international conference in Italy on underground sites and many attendees were amazed (and not a little envious!) to hear of the number of enthusiasts we have as members.

Subscribers to the 'announce' email group will know that our claims for Gift Aid from HM Revenue and Customs have recently been approved. The intention is to use this Gift Aid income to fund new activities and projects, rather than merely support 'business as usual'.

One priority is to see how expenditure might help us accelerate the migration of our website to a new platform that will allow members to upload visit reports and photographs. In addition to this, we are keen to hear members' own proposals for worthy projects, be they research or restoration, publication or education. A form to submit applications for Sub Brit funding can be found at: http://www.subbrit.org.uk/docs/reqfund.pdf .

As I write this, the continued rain has so far made conditions rather dismal this year for site visits – except for those who enjoy cave diving! By the time it is published I hope summer has at last arrived for those of us who prefer rather dryer conditions underfoot.

chairman@subbrit.org.uk

Sub Brit Committee Meeting Notes – June 2012

Chairman

Martin Dixon reported that Danuta Kozubska had completed the Independent Examination of the accounts and they will now be filed with the Charities Commission by Linda Dixon, who will take on the role of Company Secretary. The link with Cotswold Outdoor clothing had been finalised. Committee members had also attended meetings of UIS (International Speleology Group), NAMHO and SERIAC. Paddock bunker and the Cuckfield ROC post would both be open to the public as part of British Archaeology Week in July.

Finance

The Treasurer reported that Sub Brit had now received Gift Aid payments covering our retrospective claim, and that a further claim for the current year would be made in due course. With regard to Gift Aid money to be spent on specific projects, two requests for funding had been received and were discussed. In both cases, the committee asked for further information to be provided before funds were assigned. The committee reaffirmed its commitment to using some of the Gift Aid funds to improve the Subterranea Britannica website, which is our primary interface with the public.

SUBTERRANEA BRITANNICA DIARY

Summary of Forthcoming Events 2012

Sub Brit specific events

14-16 September SB UK Visits weekend – Sussex

22 September Paddock open day

29 September SB Committee

13-14 October SB Autumn Conference and visits, Liverpool (booking form www.subbrit.org.uk)

1 November Copy deadline for *Subterranea 31*

Mid - December *Subterranea 31* published

2013

26 January SB Committee

1 March Copy deadline for *Subterranea 32*

16 March Hack Green open day for SB members

End April *Subterranea 32* published

20 April SB Spring Meeting and AGM

For more information, email info@subbrit.co.uk or contact the Society concerned

Other underground-related events

11 August, 8 September Baron's Cave (entrance in Reigate castle, lower entrance) and Reigate Sandmines (entrance in Tunnel Road).

Tours from 10.00 to 1600. Entrance fee applies.

www.wcms.org.uk/pages/club/reigate_caves.shtml

29 June–1 July NAMHO conference Quarry Bank Mill www.derbyscc.org.uk/namhoconference2012

Summer – various weekends:
Coleshill Auxiliary Unit:
Replica Operational Base project. More information www.churchillsundergroundwar.org.uk.

To volunteer, contact Richard Alexander at churchills_underground_war@yahoo.co.uk

6-9 September Heritage Open Days www.heritageopendays.org.uk

21-23 September Hidden Earth UK National Caving conference www.hidden-earth.org.uk

22-23 September London Open House weekend www.londonopenhouse.org

2013

17-18 January Underground Conference, Institute of Historical Research (University of London)

27 April SERIAC (South East Regional Industrial Archaeology Conference) hosted by Kent Archaeological Society.

www.kentarchaeology.org.uk/

28 June to 1 July NAMHO conference and visits, Aberystwyth

Notes cont.

The Sub Brit Collection

The committee agreed to continue to strive to ensure that the Sub Brit Collection is made available to members as soon as possible. An index is in preparation, and assistance from members would be sought to scan the remaining photographs and documents.

Meetings

Arrangements for the Autumn meeting in Liverpool have been finalised, and a good number of bookings have been received. Early planning is already under way to identify speakers for the Spring and Autumn meetings for 2013.

Weekend Visits

The visit to Jersey in May had proved to be very successful, and arrangements for Sussex in the Autumn were essentially complete. The committee discussed possible locations for UK visits in 2013–2014, which included Devon, Shropshire, North Wales and Scotland. Possible overseas locations being considered included northern France, Denmark, Norway, Italy and the Czech Republic. Various committee members would undertake further research, and report back at the next committee meeting.

Day Visits

The visit to Thames Water's Abbey Mills facility and sewers had been attended by six members, chosen by ballot from those who applied. Over seventy people attended visits to RAF Uxbridge and Upper Heyford. Two further visits – to Kelvedon Hatch bunker and Watford ROC HQ – had already been arranged, and many other potential locations were being investigated.

Membership

Currently over one thousand, with more renewals still being received – including seventeen in the month of May.

The next committee meeting will be held on Saturday 29 September; any members wishing to raise any matter should do so in writing to the Secretary at least two weeks beforehand.

Roger Starling, Secretary

ANNUAL GENERAL MEETING 2012 MINUTES

21st April 2012 at 10.05am

Lecture Theatre 1.31, Royal School of Mines, Imperial College, Prince Consort Road, London, SW7 2BP

The meeting was opened by the Chairman, Martin Dixon, who welcomed all those attending – especially new members. 72 members were present.

1. Apologies were received from John Burgess, Inigo Bellingham, Stuart Galloway, Peter Low, Michael Dixon, Richard Savage, Tim Robinson, Bob Clary, Malcolm Tadd, Barbara Tadd, Maurice Cole, Richard Seabrook, Steve Underwood, Tim Wellburn, John Poole, Terri Jones, Stewart Wild and David Ferris.

2. The motion to adopt the Minutes of AGM of 9th April 2011, was proposed by Andrew Smith, seconded by Roy Kenneth, and passed *"nem con"*.

3. The motion to adopt the Minutes of EGM of 9th April 2011, was proposed by Andrew Smith, seconded by Bob Templeman and passed *"nem con"*.

4. The Chairman highlighted some of the key achievements of the past twelve months, as recorded in the Annual Report (which had been circulated in advance of the meeting):

- Charitable status and Gift Aid approved
- Three *Subterraneas* published
- Site Directory produced
- Members' Questionnaire issued
- Long weekends in Sweden and Manchester
- Spring and Autumn Meetings
- Member organised visits
- Fieldwork at Wartling and Coleshill
- Web updates including social networking

The Chairman also took the opportunity to look forward to some of the activities planned for 2012:

- *Subterranea*, Spring and Autumn meetings
- Long weekends in Jersey and Sussex
- Organising events in Liverpool and Kelvedon Hatch
- Using Gift Aid 'windfall' for project funding
- Website upgrade – Membership database
- Festival of British Archaeology openings
- Interpretation signing at Clapham South
- Replica Auxiliary Unit OB at Coleshill
- Working with UK and European partners

5. The Chairman said that the Sub Brit accounts had been lodged, as required, at Companies House. They had also been circulated/made available to members in advance of the AGM. In response to a question, the Chairman reported that there had been around a £3,000 increase in society reserves during the past year, largely driven by savings made from the transition to electronic communication to members, a surplus from events and a reduction in web hosting fees.

6. A motion that "nominations for election be considered "en bloc" was proposed by Sylvia Beamon, seconded by Rod Le Gear, and passed "*nem con*".

7. A motion to elect the following Officers and Committee for 2012/2013 was passed *"nem con"*.

- Martin Dixon (Chairman)
- Linda Dixon (Vice Chairman)
- Tony Radstone (Treasurer)
- Roger Starling (Secretary)
- Nick Catford (Membership Secretary)
- Paul Sowan (Member)
- Bob Templeman (Member)
- Mark Russell (Member)
- Richard Seabrook (Member)
- Andrew Smith (Member)
- Chris Rayner (Member)

The Chairman thanked resigning committee members Sue Monsell and Hugh Ainsley for their contribution to Subterranea Britannica whilst in office. He also thanked all those who had contributed to Sub Brit over the last year and announced that the committee had conferred Honorary Membership of Sub Brit on Paul Sowan in recognition of his considerable contribution to the society over many years. Paul responded by thanking the society for this honour and encouraging members to consider what role they might play in developing the society in the years ahead.

The meeting closed at 10.25am

NEWS – ARCHAEOLOGY

Astonishing graffiti discovered in a fourteenth-century cellar in Winchelsea, East Sussex

One of the several medieval cellars below properties in Winchelsea, being prepared for the National Trust for public access, has been found to have more than the expected level of interest. A large area of the fourteenth-century cellar wall has been found to be covered with depictions of at least a dozen fifteenth-century sailing ships, recalling the town's former importance as a Channel port.

SOURCE: ANON, 2012, Winchelsea's lost fleet. *Current Archaeology* 23(5)(269), page 6.

Bronze Age / Iron Age musical instrument found at High Pasture Cave, Isle of Skye

The discovery in High Pasture Cave, Isle of Skye, of a fragment of a stringed musical instrument about 2,300 years old has been reported. This is the oldest stringed instrument yet recorded in western Europe.

SOURCE: BIRCH, Steven, 2012, Skye find of note. *Current Archaeology* 23(3)(267), page 10.

NEWS – CONSERVATION AND HERITAGE

A future or closure for the Keswick Mining Museum, Cumbria

Ian Tyler, a long established mining historian and published author, has over 45 years accumulated a superb collection of Lake District minerals, mining artefacts and mines documentation. His splendid museum in the centre of Keswick, visited by Subterranea Britannica two or three years ago, has been in operation for the last 25 years. However, he now wishes to retire, and in the last two years has been searching for a buyer to take over the entire museum and continue his good work.

The asking price is £ 60,000. Sadly, as yet, nobody has emerged to keep the museum together as a going concern. If no such buyer is found by this coming autumn Ian will, reluctantly, been holding a series of sales to liquidate the collection, starting with a sale of books and mine plans in September, and continuing with sales of minerals and mining lamps in October, and other mining artefacts in October. Ian Tyler can be reached on 01228 561883 or 01768 780055.

SOURCE: TYLER, Ian, 2012, The final opportunity to save a unique part of Cumbria's mining heritage. *Down to Earth* 79 (June 2012), page 4.

Brent Council pulls the plug on London Open House 2012

London Borough of Brent has declined to fund their subscription of £4,000 to the London Open House event this year.

The local authority subscriptions allow London Open House to deliver the programme for that borough including everything from the programme development and production itself, the volunteer programme to support the openings where required, the fringe activities they develop and deliver and the marketing outputs and distribution which are many including the guide which are free for the borough's residents.

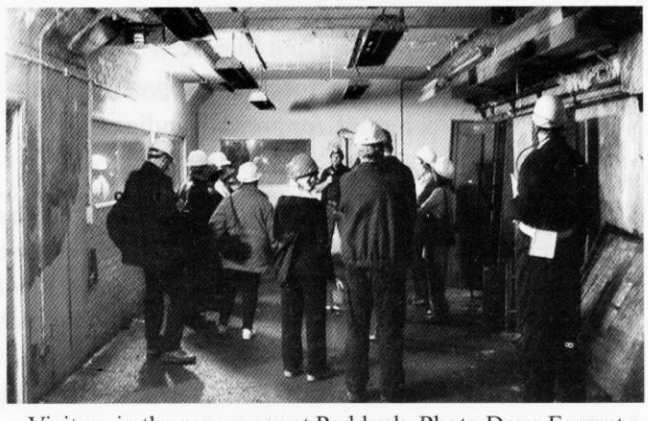
Without council support, London Open House have now to advised each of the buildings that was planning to open to the public that there will be no event in Brent this year. Without council support, there is no funding for the event to take place

London Open House has been working very hard to find a way around this but it just hasn't been possible to convince the council or find another alternative. The Brent section has now been pulled from the Guide. This means that the popular open day at Paddock on 22 September will now probably have to be cancelled.

Tours of Paddock are run by Sub Brit on behalf of the Network Housing Group who own the bunker. The London Open House event normally attracts 500+ visitors with tours at half-hour intervals throughout the day.

LATE NEWS A few of the local participants have agreed to sponsor a Brent section which has now been put back in the guide.

SOURCE: Open House London 18 July 2012



Visitors in the map room at Paddock. Photo Dave Farrant

England's industrial heritage, above and below ground

In 1986 English Heritage established its Monuments Protection Programme (MPP). The aim of this was to review all existing Scheduled Ancient Monuments; and to identify additional sites and structures of national significance with a view to their being Scheduled.

It had been recognised, and not before time, that the physical evidence remaining from the Industrial Revolution, the building of canals and railways, two World Wars, and the Cold War, has left physical remains (sometimes massive) which are every bit as important in our country's history as Hadrian's Wall, Stonehenge, Bronze Age burial mounds and the like. History has never stopped!

The industrial element of MPP, a very ambitious and – it has to be said – complex and expensive enterprise, involved EH commissioning external archaeological

consultants to review industry sector by sector, and to include suitably knowledgeable groups and individuals wherever these could be identified.

Subterranea Britannica played a part in all this, and former Chairman Paul Sowan was one of the consultants especially in connection with the cement, lime, and stone-quarrying industries: he currently has to his credit three Scheduled Ancient Monuments comprising seven structures and a mine shaft! One of these structures was a working industrial plant, visited by Paul and his pupils as an example of 'modern industry' (it dated from the 1950s) in the early 1960s!

Sadly, financial constraints led to the industrial element of MPP being closed down in 2004. Had the recommendations for Scheduling underground quarries gone ahead to implementation, he could have claimed some credit for another two or three Scheduled Ancient Monuments! Thirty-three industrial sectors were reviewed, and nearly five thousand sites and structures were evaluated. Significant numbers (including mines) were Scheduled before the Programme was closed down.

More recently, we have had an 'Industrial Heritage at Risk Project' launched on 19 October 2011. And currently member-organisations of the National Association of Mining History Organisations (NAMHO) are compiling a Research Framework for the extractive industries in England. Paul Sowan represents Subterranea Britannica on the working group, which is funded by English Heritage.

Peak District Mining Museum, Matlock Bath, Derbyshire

The Peak District Mining Museum, operated by or in association with the Peak District Mines Historical Society, is housed in the Grand Pavilion at Matlock Bath. Grand it no doubt once was, but in recent years it has been sadly neglected by its owners, Derbyshire Dales District Council. The museum occupies much of the ground floor. An adjoining staffed tourist information centre has been closed as a result of local government financial constraints. And a night club upstairs has closed, reducing income for the Council. The Museum's future appeared to be at risk.

In attempts to safeguard the Museum, the Grand Pavilion Ltd company has been established, and that body has now signed a lease of the building from the Council for three years at a rent of £1 per annum, with an option to buy the whole building for £1 at the end of that period. Funds will have to be raised by Grand Pavilion Ltd to meet running costs (including of course non-domestic rates payable to the Council) thereafter.

Temple Mine, across the road, is operated as a small tourist mine in association with the museum. There is a substantial general public footfall at these tourist attractions, but they can be recommended unreservedly to anyone with a more serious interest in mining archaeology and history. The Museum Shop stocks an impressive range of mining-related books and geological maps relating to much of the UK, not just to Derbyshire. Further details of the Museum are at www.peakmines.co.uk and of the sponsoring society at www.pdmhs.com .

The Peak District Mining Museum at Matlock Bath

NEWS – HEALTH AND SAFETY

Two missing people found dead after being buried by a landslide in Dorset

A man and a woman were left to die after being buried alive in a landslide when council officials and emergency services decided to close off a road without clearing the pile of mud and earth.

The bodies of man from Taunton, Somerset, and a woman from Crewkerne, have been discovered after apparently being trapped under a landslide at Beaminster Tunnel in Dorset for a week.

A county council spokesman said officials from its highways department had attended the scene along with Dorset fire and rescue service and police on July 7. After an "initial assessment" was carried out the road was closed. But the couple remained trapped in their car and may have died after being unable to free themselves.

Avon and Somerset Police said enquiries into the whereabouts of the man, in his 70s, and the woman, in her 60s, suggested they were in the Beaminster area on Saturday 7 July. The force asked Dorset Police to check the area before the fire service was called.

Dorset Police said: "At approximately 7.20pm on 16 July, Dorset Police were advised that Dorset fire and rescue service personnel had discovered a car under a large volume of earth outside the entrance of Beaminster Tunnel." The tunnel is expected to stay closed until September due to structural damage.

The couple have been named as Rosemary Snell (67) and Michael Rolfe (72).

SOURCE: *BBC News* – Dorset, 17 July 2012.

[**Editor's note**: Horn Hill Tunnel, on the A3066 two miles northwest of Beaminster, was designed by a pupil of Sir Marc Brunel and

opened on 29 June 1832. It is 345ft long and reduced the gradient of the road for horse-drawn traffic from 1 in 6 to 1 in 10.]

The landslide that buried the car

Sixteen miners trapped in Chinese coal mine

Rescuers have excavated a 236-metre-long tunnel to reach the 16 miners who had been trapped in a flooded colliery in Central China's Hunan province for over 60 hours, according to local authorities.

The miners were trapped in Qielichong colliery in Sandu township, Leiyang City, following a mine flood at 6 pm Wednesday. Of the 40 people working in the pit, 24 managed to escape.

But the accident was not reported to the local government until 6:30 the following day, which delayed the start of the rescue operation by almost 12 hours, according to the publicity department of Leiyang City Communist Party Committee.

Six professional teams of 90 members and more than 1,000 people were sent to the scene to carry out rescue operations.

Flood water was drained out and ventilation in the shaft was resumed but huge rocks in the passageway hampered rescue efforts. When rescuers finally reached the miners they confirmed that 11 of the 16 trapped miners were alive and would be rescued in three groups.

The mine owner, Liu Yaping, is under police custody.

SOURCE: Chinadaily.com – 7 July 2012

One of the rescued miners being brought to the surface

Seven killed and eleven trapped in Chinese colliery accident

At least seven were killed and 11 others remained trapped after a flood occurred in a colliery in early May in northeast China's Heilongjiang Province.

Rescuers said twenty-eight miners were working underground when the accident happened at about 7 am, at a shaft of the Junyuan No. 2 Coal Mine located in the city of Hegang.

So far, 10 have managed to escape on their own or with help, and rescuers are still searching for the trapped.

The cause of the accident is being investigated.

SOURCE: Chinadaily.com – 2 May 2012

NEWS – MILITARY AND DEFENCE

Saxa Vord ROTOR radar station sells for £19,000

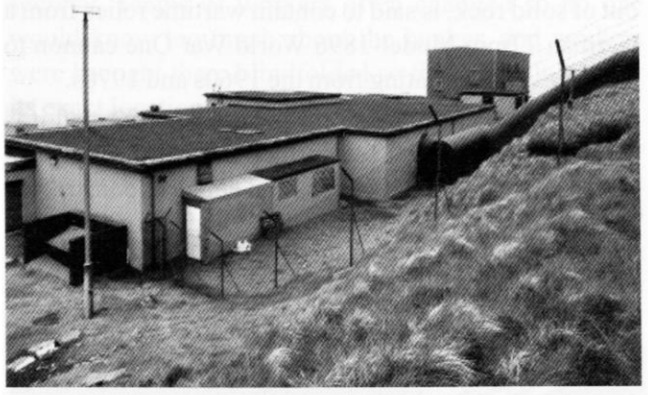
The Saxa Vord radar station on the island of Unst in the Shetland Islands closed on 1 March 2006 and was placed on a care and maintenance basis. The installation above the station was retained as an unmanned communications station.

The first radar station at Saxa Vord became operational in September 1940 equipped with CDU (Coast Defence U-Boat) radar, the Naval version of CHL. Its role was tracking submarines and shipping attempting to break out into the Atlantic. It was also able to plot aircraft and was to play a major part in the destruction of several German aircraft in the area. Saxa Vord closed down in July 1945.

In 1955 construction of a new radar station, on the same site, started as part of the final stage of the ROTOR Programme (Rotor 3) to provide radar cover for the north and west of the British Isles which were still exposed to attack and to give low and surface level cover over the Atlantic. It was a Centimetric Early Warning (CEW) station equipped with Type 80 Mk 2, Type 13 & Type 14 radars. The new CEW operations buildings were to be above ground and designated R10, similar in internal layout to the underground R1 bunker. The station became operational in 1957.

Following the demise of ROTOR, the air defence of the UK was reorganized once again. ROTOR gave way to a system of Master Radar Stations (MRS) that provided radar coverage of the UKADR, the United Kingdom Air Defence Region. In the mid 60s, M R stations started to give way to the Linesman/Mediator system that was served by radars from RAF Saxa Vord in the north of the Shetland islands, RAF Buchan, near Peterhead, Scotland, RAF Boulmer in Northumberland, RAF Staxton Wold in Yorkshire, and RAF Neatishead in Norfolk.

In about 1980/82 during the 'Plan Ahead' period, a new surface operations block, designated an R101 was built on the west side and below the R10.



The R10 surface bunker at Saxa Vord. At the time of sale, the bunker was found to be in poor internal condition. Photo Nick Catford

Saxa Vord acted as a reporting post for the United Kingdom Air Surveillance and Control System. UKASACS is comprised of a number of individual static and mobile units which provide the minute-to-minute information on air activity required to defend the UK and our NATO partners. The information within the RAP is used by the Air Defence Commander when deciding whether to investigate or perhaps even destroy an aircraft flying in an area without permission. Information is fed into the RAP from the RAF's ground-based radars and from the air defence systems of our neighbouring NATO partners.

In the summer of 1999 it was proposed to run down RAF Saxa Vord and it was downgraded to a satellite of RAF Buchan. In April 2004 this decision was reversed with the station being upgraded to an independent operation once again following the announced draw-down of RAF Buchan. This however was to be short-lived and closure came two years later.

The technical site and domestic camp were offered for sale by auction in June 2012. The property comprised a selection of single storey, flat-roofed buildings including both the R10 and R101 bunkers, one three-storey, hardened office building clad in profiled metal sheeting, and a selection of associated structures on an area of sloping hillside.

Visitors (only three turned up) on the viewing day found the 1989-built R101 CRC Bunker in excellent condition; however, the Rotor period R10 building was heavily contaminated with mould and damp. The site was sold for £19,000 without any services, and the MOD have refused to connect it to their supplies which still feed the retained communications site above.

The domestic site was offered for sale as a separate lot with a total reserve of £200,000. It comprised 24 houses which were built between 1960 and 1980. Not all the houses were sold.

SOURCE: Sub Brit website and *The Press & Journal,* 29 June 2012

A Piece of the Atlantic Wall Uncovered

German bunker comes to light on the north Brittany coast

People strolling last Monday morning on their way up to La Pointe de Bihit, a local viewpoint on the coast near Trébeurden, were surprised to come across a large hole in the roadway. The local mayor Michel Lissillour and the Council's highway engineers were quickly summoned to assess the damage. "We discovered a gaping hole about 40 cms wide and three metres deep", they reported.

Their first job was to close the road to all traffic. "This road is one of the busiest in the area," said the mayor. "Every day hundreds of cars, motor homes and buses pass here on their way to the viewpoint. Imagine what would have happened if the road had collapsed when traffic was passing."

Reinforced concrete

The highway engineers soon got to work. The road surface was lifted to allow a mechanical digger to excavate around the hole. Then, another surprise: "We discovered one metre below the surface an opening into the roof of a reinforced-concrete bunker, with masonry walls," the mayor told us. Amongst the debris were several artefacts dating from World War II that have been sent to a museum.

Eventually a gaping void of impressive dimensions was uncovered, the entrance to a large underground gallery that continued under the adjacent fields. The hole was later excavated over a larger area to ensure no further surface collapses, then the whole lot was filled in with rocks and hardcore before resurfacing once again.

The bunker has once again become a sad piece of history.

SOURCE: French newspaper *Ouest-France* 15 May 2012 – translation by Stewart Wild.

Plans to demolish standby set house at Goosnargh

A religious group has submitted plans to build a gospel hall at a former Royal Air Force base.

The Blackgate Trust wants to demolish the building which was used as an emergency power supply for two underground bunkers at Goosnargh near Preston in Lancashire. The bunkers and the power house date back to WW2 when they housed 9 Group Headquarters. After the war one of the bunkers housed ROC 21 Group HQ and Western Area Sector Operations Centre.

The trust represents an Evangelical Church community in Whittingham and Goosnargh. It wants to hold two Sunday services for 75 to 100 worshippers, morning prayers and occasional bible meetings at the hall.

A spokesman for Steven Abbott Associates, on behalf of the applicants, said: "The trust is seeking to provide and administer an appointed place of worship on the site of a former Ministry of Defence power/generator building, which will be demolished. The site was selected due to its ability to serve the rural church community. The

proposed building is modest in terms of its size and design and will be much more appropriate than the existing large structure on site."

The elegant WW2 power house could be demolished to make way for a gospel hall. Photo Nick Catford

Similar plans were submitted in 2008 but the parish council raised objections and the group withdrew them. Councillors believed such a facility was contrary to policy governing development in the open countryside and would not be sustainable.

Speaking of the new plans, the spokesman added the government recently published reforms which require "the planning system to promote and deliver community facilities including places of worship".

Julie Buttle, clerk of Whittingham Parish Council, said concerns had been raised about parking and the applicant acknowledged parking on Whittingham Lane would not be acceptable. She added: "The council will make a recommendation once the planning application is presented." It will be decided by Preston Council planners under delegated powers, unless objections are received.

SOURCE: *Lancashire Evening Post* 22 July 2012

World War II air-raid shelter at Prestongrange Colliery, East Lothian

Investigation of a former glassworks near Musselburgh and Prestonpans, east of Edinburgh, has revealed a redundant flue tunnel to have been adapted as a World War II air-raid shelter by the Prestongrange Colliery. The stone-built vault was reinforced by the introduction of steel supports and the erection of one or more brick blast walls.

SOURCE: CRESSEY, Michael, Melanie JOHNSON, George HAGGARTY, Jill TURNBULL, and Hugh WILLMOT, 2012, Eighteenth-century glass and pottery manufacture at Morison's Haven, Prestongrange, East Lothian. *Post-Medieval Archaeology* 46(1), 36 – 55.

Stash of military vehicles found in tunnels beneath a French forest

A sprawling military bunker containing a treasure trove of vehicles and weaponry spanning both world wars has been discovered at a secret location deep within a French forest.

Like a giant time capsule, the huge installation, carved out of solid rock, is said to contain wartime relics from a German 77mm Model-1896 World War One cannon to military vehicles dating from the 1960s and 1970s.

Although the exact location has not been revealed it is believed the bunker once formed part of the Maginot line - the array of fortifications and defences constructed along France's borders with Italy and Germany after World War One.

Some of the vehicles are very well preserved with fully inflated tyres and a noticeable lack of rust, prompting some experts to suggest they are part of a private collection that has been moved there recently.

SOURCE: *Daily Mail* 2 May 2012

An amazingly well-preserved World War Two-era military truck sits gathering dust in the huge bunker discovered at a secret location in a French forest.

Tito's secret bunker in Bosnia–Herzegovina now open to the public

The secrets of one of the most intriguing figures of the old communist bloc are laid bare in an underground nuclear bunker in Bosnia-Herzegovina that's now open to the public. The bunker is number D-0 in the town of Konjic, 50km southwest of the capital Sarajevo. The bunker was built for Josep Broz Tito, former leader of Yugoslavia, even though he never went there.

A colossal building, its construction began in 1953 and ended in 1979, a year before Tito's death. The whole complex sprawls across 611 square metres, dug 300 metres into a mountain. The cost of this work was astronomical – nearly US$5 billion. It was created to save the entire Yugoslav ruling class from a nuclear attack. It was built to withstand an attack with bombs up to 25 kilotons.

In the event of an attack, the bunker could accommodate President Tito, his family and his closest collaborators – about 350 people. From here it would be possible to govern the country, or what was left of it. It's a kind of labyrinth, a complex of residential areas, conference rooms, offices, halls for strategic planning, a 'presidential bloc' and other sections.

The construction of the tunnel was completed in total secrecy. Teams of workers often changed so no one would know too much about the bunker, and workers were brought there blindfolded so they wouldn't know its exact location.

Once it was finished, only four generals were allowed to enter. Sixteen soldiers took care of maintenance: nine Serbs and seven Bosnian Croats. When Yugoslavia fell apart just before the war in Bosnia, Serbs and Croats largely dismantled military installations in this region with its mountainous and little-used routes.

What could not be broken down, like the largest underground military airport near Bihac, the Serbs have blown up. In 1992 the Serbian high command in Belgrade gave the order to destroy the bunker in Konjic. It was a Bosnian military guard who sabotaged the operation, saving everything.

Since then, the building, with all its signs and symbols, its furnishings and its instruments, has been fully preserved.

Visitors are greeted by large colour photos of the president in his black uniform with gold badges and a chest covered with medals. In Bosnia and Herzegovina respect for his memory is preserved, even today.

As well as Tito nostalgia there are also some examples of retro design, with everything firmly dated and perfectly preserved. Furniture covered with Formica. Pristine toilets manufactured in Banja Luca, Bosnia-Herzegovina's second-largest city. The conference room with 72 seats upholstered in a mustard shade. Two air-conditioning systems – one that was set aside just for Tito's accommodation – that even today maintain a temperature of 23-24 degrees and 60 percent humidity. Huge shelves holding gaskets, screws, drills, light bulbs and hammers. There are also old tape recorders and dozens of Siemens telexes.

There is an old contraption that allows you to record and play back your voice, an ancestor of modern recorders. An array of vintage analogue technology is on display, most notably, the 'red phone', which is seen in so many spy movies. These telephones are considered the true icons of Tito's Yugoslavia. They were produced by the Iskra ('spark') company, an electronic equipment manufacturer in Slovenia from the Sixties to the Nineties. The bunker is also now a venue for a biennial of contemporary art exhibition.

SOURCE: Gulfnews.com, 17 July 2012

Newcastle upon Tyne air-raid shelter open to the public

The space underneath Newcastle's Grainger Market was used as a wartime air-raid shelter.

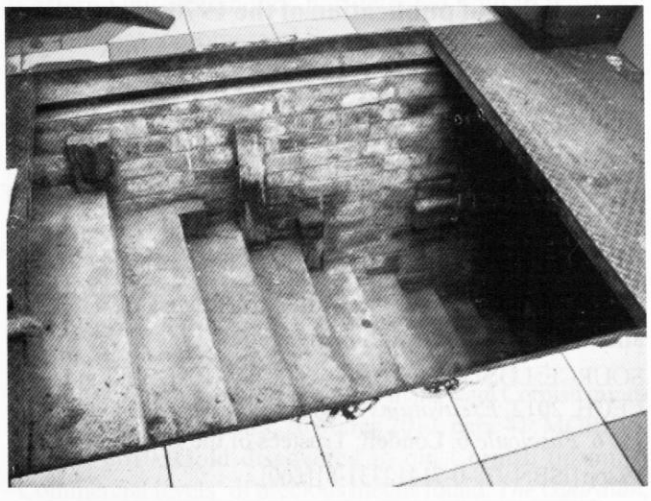
The shelter was opened up in July 2012 as part of a two-day exhibition about the Grainger Market's wartime history giving the public a rare glimpse inside. Curious shoppers flocked to the inconspicuous entrance stairs, normally hidden beneath metal grates next to the market's plant stalls, to peer into the gloom.

These days the shelter has been partially blocked off, but it's thought the tunnels stretch to Central Station – and maybe even beyond.

Operational manager for Newcastle markets, Heather Thurlaway, said: "We believe the shelter was built in the 30s, although there are also basements under many of the market stalls. A lot of people are very interested in the market, and we have been trying to open up these areas of interest." The tunnel was open as part of Love Your Local Market fortnight.

The Grainger Market was built by Richard Grainger and architect John Dobson in 1835, and still sees some 200,000 shoppers meander through its aisles each week.

SOURCE: *Evening Chronicle,* 4 July 2012



The access steps into the air-raid shelter

Norwegian submarine base for sale

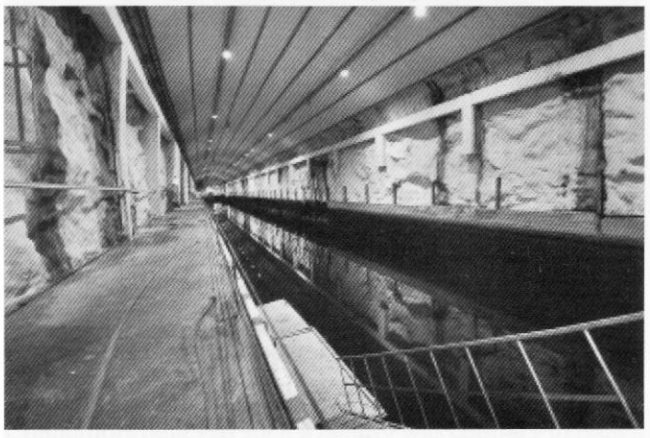
The Royal Norwegian Navy has announced that it is selling off Olavsvern Naval Base, a state of the art submarine base on the northern coast of the country for $17.3 million.

The property has approximately 13,500 square metres of buildings above ground, about 2,500 square metres quay and a real mountain resort of about 25,000 square metres consisting of among other things: Dry dock for submarine, workshops, garages offices, fuel store and a warehouse.

The base was originally built in 1967 at a cost of $494 million dollars and was used by NATO as well as the Royal Norwegian Navy up until 2002, when the base was converted to a supply depot with little to no full-time staff.

The Royal Norwegian Navy still has the much older, larger, and more formidably named underground naval base at Haakonsvern.

Source: Geekologie website, 29 May 2012



World War II air-raid shelter tunnels opened to the public at Cardiff Castle

World War II air-raid shelter tunnels at Cardiff Castle are now opened for public visits.

SOURCE: ANON, 2011, Castle opens wartime tunnels. *Group Travel Organiser*, November / December 2011, page 31.

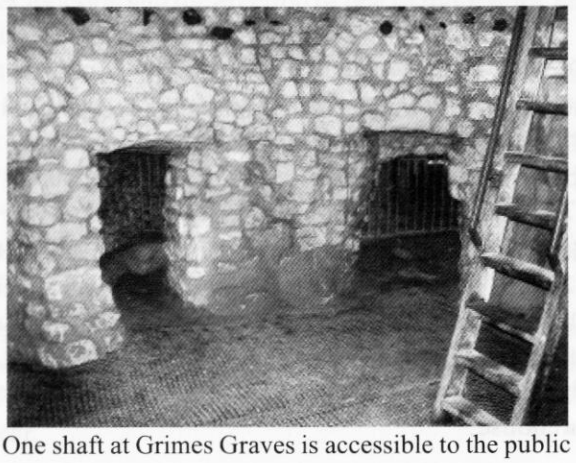
NEWS – MINES AND MINING

Completion of publication of the 1970s excavations at the Grimes Graves flint mines, Norfolk

The sixth and final part of the report on the Grimes Graves excavations of 1972–1976 has now been published. The site, bought for the nation in 1931, comprises 20 hectares of mined chalk which is estimated to have yielded up to 20,000 tonnes of flint in prehistoric times from which tools and weapons were fabricated, including around two million flint axes.

The site is located seven miles northwest of Thetford and is managed by English Heritage

SOURCE: LONGWORTH, Ian, Gillian VARNDELL, and Jacek LECH, 2012, *Excavations at Grimes Graves, Norfolk, 1972–1976. Fascicule 6*. London: Trustees of the British Museum: 192pp [ISBN 978-0-71412331-8] [£60].



One shaft at Grimes Graves is accessible to the public

New potash mine proposed on North York Moors

A cloud of uncertainty surrounds the environmental impact of a proposal to create a massive minerals mine in the North York Moors National Park.

Details of the scheme, including its location and operation, are not set to be unveiled until October, but conservationists and residents fear it could have a devastating impact on the highly-protected landscape.

Depending on the location of the mine-head, moorland birds, such as merlins and curlews, reptiles and small mammals, could be affected, while concerns have been raised over possible leaks from its proposed 40km-long pipeline from the mine-head to Teesside.

The firm has said that the excavation of its two 4km tunnels, a 1,500 metre-deep mine and a mine-head would produce more than 500,000 cubic metres of spoil, but it has not developed a plan as to how it would be removed or dispersed on the site.

In an attempt to dispel local concerns a spokesman said: "We will do everything possible to minimise the impact of the proposals, both visually and operationally, and are investigating what operations could be conducted underground to minimise the mine-head size."

Where possible, the firm says it would use the moorland landscape to screen the mine-head, which a growing number of people believe could be in a plantation near Littlebeck, southwest of Whitby.

The firm said that due to technological advances, its proposed mine would be significantly different from the one at Boulby, which was designed and built more than forty years ago, while pledging to donate funds to offset the environmental damage.

SOURCE: *Northern Echo,* 12 June 2012

Mine and quarry exploration, Gloucestershire

The February 2012 issue of the newsletter of the Gloucestershire Speleological Society contains several items on visits for exploration and recording purposes in ironstone mines in the Forest of Dean, and underground stone quarries in the Cotswolds.

In the Forest there are illustrated accounts of and news relating to ironstone mines. At Noxon Park mine, near Bream, unusually low water levels have allowed easy access to passages usually accessible only to cave divers. At Wigpool ironstone mine, an access agreement is nearing completion whereby the proprietors of Clearwell Caves will delegate access control to the Society. There is also an account of a visit to the somewhat unusual underground stone quarry at Bixhead – unusual because sandstone, rather than limestone, was quarried here (other examples are, for example, in Lancashire and Scotland).

Still in the Forest, Daniel Howell has now succeeded John Harvey as Deputy Gaveller.

In the Cotswolds, underground limestone quarries at Bathampton and Windrush are featured.

Editor's note: Members of Subterranea Britannica have visited Bixhead and Windrush, as well as several of the ironstone mines, during the course of Study Weekends.

News from Nenthead, Cumbria

The adverse economic climate has forced the managing body of the mining heritage centre at Nenthead to go into administration, and the closure of the centre (interpretation centre, guided tours underground, café, and bunkhouse accommodation). The impressive surface archaeological remains and reconstructions remain accessible to view, as public footpaths run through the site, the owner of which is Cumbria County Council.

A new mining history or conservation society is being formed and might, it is hoped, take possession of certain of the remaining assets. *www.nentheadmines.com* However, it is estimated that an income of at least £5,000 p.a. will be needed to meet necessary outgoings, such as insurance for example.

[**Editor's note:** Members of Subterranea Britannica visited Nenthead, England's highest village, in the course of a Cumbria study weekend in September 2007 – see *Subterranea* 15 (December 2007) pages 23–26.]

The smelt mill at Nenthead Mines

News of interest to rock-salt miners in the British Isles

Three deep mines in the British Isles extract rock salt, used almost exclusively to treat ice-bound roads. The active mines are at Winsford (Cheshire), Boulby (on the East Yorkshire Coast), and Carrickfergus (Northern Ireland).

Boulby is primarily a potash mine, but also yields rock salt as a by-product. The mines dig out and stockpile salt throughout the year, and of course sell it to meet the winter demand from highway authorities who maintain their own smaller stockpiles. Two unpredictably severe winters saw unanticipated high demand, dwindling stocks, and hundreds or thousands of immobilised or stranded motorists. And of course getting personnel to the stockpiles, and the salt from the stockpiles to where it was wanted, wasn't helped by ice-covered roads.

Highway authorities, being very aware of the pressure of financial cutbacks, are obviously anxious to reduce the cost of road treatment. And it is well-known that salty meltwater is environmentally damaging, both to roadside vegetation and as it causes severe corrosion of constructional metals.

Research has now been published indicating that simple and environmentally safe modification of the salt and spreading regimes can achieve enhanced de-icing results using lower volumes of material. So now highway engineers as well as the diet and health conscious can 'cut down on salt'.

SOURCE: PLUMB, Christopher, and Richard JORDAN, 2012, Research enables UK roads safely to cut down on salt. *Proc. Institution of Civil Engineers* 165(1), 42 – 48.

New life for mining in Cornwall and Devon?

Wolf Minerals, based in Australia, has proposed recommencement of mining for tungsten at Hemerdon, north of Plymouth. The super-dense metal was last mined here during World War II, in an area which has been described as containing the world's fourth largest deposit.

Opencasting could commence in 2014, with an estimated output of 345,000 tonnes per annum. Soaring world prices for the metal could make this a viable commercial operation. The extremely high melting point of tungsten (3,422 °C) has historically made it the preferred material in incandescent filament lamps, although these are now being superseded by more efficient lighting devices. Tungsten carbide, however, remains in high demand as an abrasive.

Western United Minerals has detected gold in what are described as 'commercial levels' at South Crofty tin and copper mine (closed in 1998) near Camborne. The company also views copper, tin and zinc as other possibly workable resources here.

The same company has also identified the rare soft metal indium as recoverable at commercially viable costs at South Crofty. This obscure metal is essential in many modern electronic devices including touch-screens, liquid crystal flat screens, digital time-pieces, and GPS receivers.

SOURCE: LEA, Robert, 2012, Australians want Cornish mines to thrive again. *The Times*, 26 March 2012, page 41; MORRIS, Steven, 2010, Gold discovered in old Cornish tin mine. 'Commercial levels' of precious metals found. *The Guardian*, 7 May 2010, page 20; TAYLOR, Joel, 2011, iPod element could revive Cornish mine; *Metro* 11 February 2011, page 32.

Lawfield mine investigation, Cockburnspath, East Lothian

Members of the Grampian Speleological Group have continued to investigate a mine entrance in sea cliffs at NT 75923 73385 north of Cockburnspath, East Lothian. This was found to be blocked in 2009, but had been reopened by wave action in June 2011.

With a gas detector for safety (the mine may have been for coal) members have found the tunnel has two branches, one extending 71.5 metres to a dead end, the

other 54 metres leading to a water-filled shaft down to a lower level. Digging in soft mud in the passages reveals their original height to have been two metres, and a drainage channel leading to the beach.

Another mine entrance (possibly linked) has now been reported 45 metres to the south. This also has a drainage channel.

Archival research has revealed little, although it is thought the Cockburnspath mine resembles a known seventeenth-century coal working at Cove, to the south. A reference has also been found to the digging of a tunnel for coal at Dunglass Dean, about a mile to the south, as far as Lawfield Farm. The tunnel leading out to the beach may be a part of that mine, created to facilitate coal transport. Both the Old and the New 'Statistical Accounts of Scotland' imply that coal-mining in the immediate area had ceased in the early 1700s.

SOURCE: LINDSAY, Stuart, 2011, Lawfield mine. *Newsletter, Grampian Speleological Group* 147 (July 2011), page 12.

Roof fall suspected in Nine Lums limestone mine, Fife

Nine Lums limestone mine is an impressively extensive network of mined tunnels in quite steeply inclined strata near Burntisland on the north side of the Firth of Forth.

When last visited by your reporter (Paul Sowan) a very large open entrance led into a complex of tunnels on several levels, with some confusing constricted routes through semi-collapsed rock, a large deep shaft up to the hill surface above, and a drift tunnel with rails leading out towards the coast.

It is understood that access has not been granted by the land owners or occupiers in recent years. It has been reported that a roof fall within the mine has been heard by a person passing the entrance.

SOURCE: ANON, 2011, Collapse in Nine Lums mine? *Newsletter, Grampian Speleological Group* 147 (July 2011), page 14.

Reworking of colliery spoil tips, Yorkshire

A Doncaster based company, RecyCoal, specialises in the recovery of small coal from old colliery spoil tips (sometimes quite inappropriately called slag heaps). The company, which has been in business for around thirty years, currently proposes coal recovery and a major restoration scheme at the former Smithywood coking plant near Sheffield.

SOURCE: DARMON, Chris, 2012, There's still money in old coal tips. *Down to Earth* 79 (June 2012), page 5.

Gold mining in prospect in Northern Ireland

Dalradian Resources, a Canadian exploration company which specialises in gold, has renewed the search for economically winnable deposits of the precious metal at Curraghinalt on the borders of County Londonderry and County Tyrone in Northern Ireland.

Continuing where earlier searches have been conducted, the firm has detected at least seven gold-bearing veins from a half to three metres wide by drilling 250 sampling boreholes with a total length of 26,000 metres. They estimate the resource to contain 460,000 ounces of gold in 1.1 million tonnes of rock (12.84 grams of gold per tonne), and a further 2.23 million ounces of gold at a lower grade. The prospection area comprises 84,000 hectares of Precambrian rock.

Previous exploration by Ulster Minerals and Minco plc resulted in a 412-metre shaft, 225 metres of lateral drifts (horizontal tunnels) and a 60-metre ventilation shaft, so even if no economically workable gold is mined, there will at least be a legacy of holes in the ground to explore.

SOURCE: DALRADIAN RESOURCES, 2012, Dalradian's Northern Ireland project. *Down to Earth* 79 (June 2012), page 6.

NEWS – MISCELLANEOUS

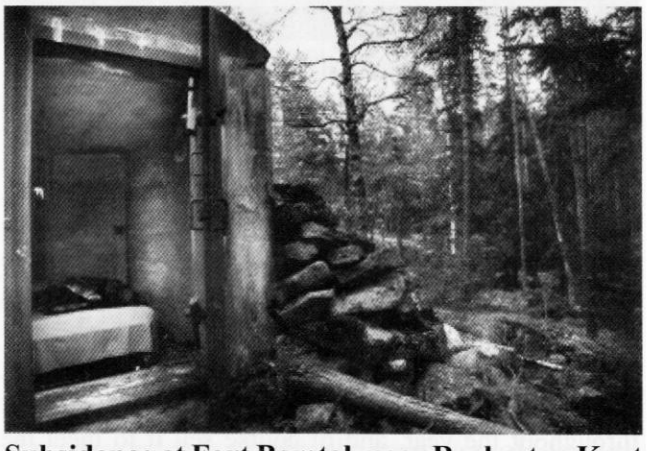
Swedish sex chamber discovered

Police investigating a suspected crime scene in Sweden were shocked to learn it was a woman's secret sex chamber.

Two fishermen contacted the authorities after finding the 'dungeon' in an abandoned military bunker near the town of Nordmaling. It featured a bed, ropes, leather restraints and adult toys. But when news of the hide-out became public, a single mum called Lena came clean about the bunker.

Lena, who is in her 40s, admitted equipping the room for trysts with a man she had recently met but said she had learnt her lesson. "I just wanted to test my limits," she said. "Sweden is not really such a free country when it comes to sexuality."

SOURCE: *Orange News*, 13 June 2012.



Subsidence at Fort Borstal, near Rochester, Kent

Members of the Kent Underground Research Group have investigated a subsidence in a defensive ditch at Fort Borstal, part of the Chatham defences, built about 1875. A fissure led down to a circular shaft sunk through chalk which was found to be blocked by fallen rubble about 4.1 metres down. The feature has been interpreted as a pre-existing chalk-well (an antique species of chalk mine) discovered during the construction of the fort.

SOURCE: Le GEAR, Rodney F., 2011, Subsidence at Fort Borstal, January 2011. *Newsletter, Kent Underground Research Group* 103, 4 – 5.

Bill Clinton's underground fund-raiser in tunnels beneath Waterloo station goes down like a damp squib

An exclusive event hosted by Bill Clinton and attended by a host of celebrity friends has been criticised after guests who paid up to £1,000 for tickets were left queuing outside for hours.

Attendees complained the underground venue beneath Waterloo station "stank", with perspiration "dripping off the walls" and the rooms too crowded to even see the former president.

One, who called it the "worst party ever", described how "angry people" were waiting in the queue outside while high-profile guests were admitted, and another condemned the event as "unpleasant".

The evening had been intended as a fund-raising event for the Clinton Foundation Millennium Network, which was set up to "encourage the next generation to address global challenges". Hosted by Bill Clinton and his daughter Chelsea, the night was attended by actress Gwyneth Paltrow, model Lily Cole, performer Will.I.Am and Princess Beatrice.

Glamorous photographs of the event document Clinton's short speech addressing the issue of climate change, as well as smartly-dressed attendees enjoying themselves.

SOURCE: *Daily Telegraph,* 23 May 2012.

Celebs line up beneath Waterloo station. Included here are Will I Am, Gwyneth Paltrow, Bill Clinton and Chelsea Clinton.

A Fingal's Cave grotto near Kelvedon, Essex

Fingal's Cave, on the island of Staffa in the Inner Hebrides, is noted for its spectacular display of columnar basalt, the cave walls being composed of substantial polygonal-on-plan columns (more or less six-sided) of the fine-grained volcanic lava. Such basalt formations are also found (usually without caves) at the Giant's Causeway in Northern Ireland, and at numerous places in Iceland. They are formed by tension cracks resulting from the lava cooling, solidifying, and contracting.

An attempt to recreate some semblance of the Scottish cave has recently been reported in the grounds of Braxted Park, Kelvedon, Essex, where imported basalt columns have been emplaced. The creator of this lakeside artificial cave (an earthed-over surface structure) in or about 1804 to 1806 reportedly recruited a 'hermit' to live in the 'cave' for a year without washing or shaving!

Peter Du Cane II paid his cave-man £ 100 for the year! The existence of the original Fingal's Cave became known to the outside world as a result of a visit to Staffa by naturalist Joseph Banks [1743–1820] in 1772. The name derives from a supposed association with reportedly ancient Scots poetry credited to one Ossian and published in 1761–1765. The Essex 'cave' has been Scheduled as an Ancient Monument.

ANON, 2012, Fingal's Cave found in Essex. *Current Archaeology* 23(1)(265), page 8.

Underground public toilets converted to living quarters at Crystal Palace, south London

Underground public toilets at the south end of Crystal Palace Parade, south London, have been successfully converted into a compact residential flat, comprising a bedroom, living room, kitchen and bathroom – with a 'courtyard garden' at the surface,

SOURCE: CLARK, Laura, 2012, Successful loo conversion is a big relief for homeowner: derelict underground toilet is transformed into contemporary flat. *Croydon Advertiser*, 6 April 2012, page 36.

The underground des res at Crystal Palace

Network Rail virtual archive online

A selection of Network Rail architectural and engineering drawings can now be accessed online at www.networkrail.co.uk/virtualarchive . It is reported that Isambard Kingdom Brunel's original drawings for the Box Tunnel on the Great Western Railway between Chippenham and Bath Spa are included.

SOURCE: NETWORK RAIL, 2012, Railway archives brought to life. *Modern Railways* 69(763), page 36; also *Bull. Railway and Canal Historical Society* 437, page 9.

French driver confuses metro entrance for underground car park

A confused driver has ended up trapping his car on the steps of a Paris metro station, after mistaking it for the entrance to an underground car park.

"There's a sign saying 'Haussmann Parking' right in front... I made a mistake," claimed the driver, identified only as Johan. The 26-year-old managed to brake in time to stop the vehicle, leaving the back wheels sticking out.

No one was hurt in the incident, which immediately drew a crowd of onlookers. Many took pictures of the car – a Dacia Duster – stranded on the stairs at the Chaussée d'Antin–La Fayette metro station.

The driver was later asked by French police to do an alcohol test, which he passed.

A member of staff at a local restaurant said that a similar incident took place at the site about five years ago.

SOURCE: *BBC News – Europe*, 24 April 2012.

Abandoned Glasgow mines could provide 40 percent of city heat

A recent report states that heat from Glasgow's mine-waters could provide the city with energy.

Almost 40 percent of Glasgow's heat could be provided by tapping into waters from abandoned mines underneath the city, according to the British Geological Survey (BGS).

The BGS is working with Glasgow City Council to identify which areas of the city could supply geothermal energy. They believe this new source of energy could help Glasgow meet government targets to lower carbon emissions. The city is aiming to provide 11 percent of heat from renewable sources by 2020.

In a report on the potential for geothermal heating in Glasgow, the BGS said the city's miners had left a "valuable inheritance" in the form of waters now held in the shafts and tunnels underneath the ground.

It said heat pumps, which work in the same way as fridges, could be used to "concentrate" heat energy from mine-waters, making the water hot enough to heat buildings.

A small-scale scheme using mine water to heat 17 houses in Shettleston has been running for more than ten years. Glasgow City Council and the BGS now want to extend this scheme to cover a larger proportion of the city and are calling on developers and local communities to come forward and identify possible projects.

SOURCE: *BBC News - Glasgow*, 19 April 2012.

Underground hotels planned for London

A gloomy underground car park in Bloomsbury is to be converted into London's first subterranean hotel. Two basement floors of the NCP under Great Russell Street will become £80-a-night "rooms without a view" according to recent plans.

The developers of the 175-room hotel say it will provide budget accommodation in the heart of an expensive city. However, some residents compared the hotel to the use of Tube stations as overnight bunkers during the Blitz.

In a newsletter, the Bloomsbury Association urged residents to lodge objections to the plans with Camden Council on grounds ranging from "loss of off-street parking" to "the threat to public health, safety and security".

Some residents are also concerned about noisy "backpackers" arriving at and leaving the hotel 24 hours a day. But the developer, property group Criterion Capital, rejects the claims as "rubbish" and says the hotel – called The LDN – will provide stylish accommodation for discerning travellers. A spokesman said: "There are no residents within at least 500 metres."

If Camden approves the plans the hotel, yards from Tottenham Court Road Tube station, will open in 2014. Existing car ramps will be converted to accommodate the new hotel's entrance lobby in Adeline Place.

The rooms, on the fourth and fifth basement floors, will range in size from 11 sq metres to 22 sq metres and include an en-suite lavatory and shower. It is thought to be the first subterranean hotel in central London although one is planned in a development underneath Hersham golf club in Surrey.

The deepest underground hotel rooms are 155 metres down in a former silver mine in Sweden.

Criterion is also planning a much bigger 650-room capsule hotel, also under the LDN brand, in the Trocadero in Shaftesbury Avenue, also opening in 2014.

SOURCE: *Evening Standard,* 15 June 2012.

Massive Cold War-era foundations (but no bunker) at Woolwich, London

An 'apparently unremarkable' four-storey civic building in Woolwich, south London, built in the 1960s, proved to have astonishingly massive heavily reinforced concrete foundations. But the former students' hall of residence did not conceal a secret bunker, as might have been suspected. It was a case of 'overbuild' to withstand extremely heavy loads, 'designed at the height of the Cold War paranoia'.

The demolition of this structure, to make way for the new Woolwich Central residential and retail development, called for the use of some of the world's most powerful demolition and excavation equipment. Excavators with capacities of 45 to 75 tonnes were used. With structural spans of up to 16 or 17 metres (rather than the six metres common at the time), the building called for an astonishingly massive foundation slab, and support columns up to one metre square.

SOURCE: COLE, Margo, 2011, Woolwich demolition. *New Civil Engineer*, 25 August / 1 September 2011, page 14.

Wealden Cave and Mine Society sets a good example in Surrey

The Wealden Cave and Mine Society, a caving club with strong expertise in the numerous mines and underground quarries in east Surrey (including several which are important bat hibernation sites), works in collaboration with the Surrey Bat Group. WCMS control access (by agreement with owners and occupiers) to a number of mines and quarries and, for those known to be used by bats, restrict access during the hibernation season, approximately October to March (depending to some extent on the weather).

The SBG has recently published records for hibernating bats noted during the winter of 2011–2012. Alongside mine and quarry sites at Godstone and Westhumble are others for derelict lime kilns and for grottoes, ice-houses and subterranean garden follies. The report also discusses to what extent high hibernating bat counts underground correlate positively with spells of cold weather.

Similar collaboration between cavers, mine explorers, and bat recorders occurs throughout the British Isles, with noteworthy examples (to your correspondent's knowledge) in the Forest of Dean (Gloucestershire Speleological Society) and Kent (Kent Underground Research Group). Members of Subterranea Britannica are reminded that bats are a legally protected species. They should not be disturbed, and certainly not photographed if seen hibernating (a criminal offence).

SOURCE: SURREY BAT GROUP, 2012, 2011–2012 hibernation season. *The Bat Detector* 64, 2 - 3 [Records for hibernating bats in lime kilns at Betchworth and Brockham, mines and quarries at Godstone and Westhumble, and underground garden features in Surrey]

Underground gas storage in the UK

Gasometers (or more correctly gasholders) were once a common feature of even quite small towns. They are disappearing rapidly, not because of any decreasing need to store hydrocarbon gases, but because there are now less visually intrusive ways to store the material (compressed within the mains themselves).

There are now two principal answers to the storage problem. Now that the country is criss-crossed with large diameter high-pressure gas pipelines, those very pipes fulfil the previous functions of gasholders. Over and above the capacity of the pipelines, we have man-made subterranean storage caverns. Generally unlined, such caverns are excavated in suitable rocks, especially rock salt but also argillaceous chalk. The impermeability of the rock, along with the external pressure of groundwater at depth, prevents the gas from leaking out.

The civil engineering firm Atkins is currently working on six rock-salt gas storage caverns within the UK. One of these is the King Street Energy Development in Cheshire. 'Caverns' with a maximum diameter of 110 metres, and a depth of up to 170 metres, are in prospect.

SOURCE: ANON, 2012, Underground storage. *New Civil Engineer*, 5–12 April 2012, page 18.

Memorial to the 173 people who died at Bethnal Green Underground station, London

The worst civilian disaster during World War II was at Bethnal Green London Underground station. What proved to be a false air-raid alarm resulted in a great many people panicking and seeking safety in the station. Somebody seems to have stumbled or fallen near the bottom of the steps down to the platforms. Those behind kept pressing inwards and downwards. The result was a massive pile of people, those at the bottom being crushed to death – 173 of them, and over 90 injured.

The intended concrete and timber memorial, at the surface, is to incorporate a representation of the flight of steps. It recalls the cramped volume of space in which so many died. Construction of the memorial was scheduled to start in March 2012, with completion in three months.

SOURCE: ANON, 2012, Waldeck to supply Tube memorial plinths. *New Civil Engineer*, 5 and 12 January 2012, page 38.

The Papal bunker, Vatican City

The Vatican's archives are stored on fifty miles of shelving, some of them in a 'high security underground bunker'. There are documents relating to the Roman Catholic Church's relations with Henry VIII, Galileo, Martin Luther, and others.

SOURCE: SQUIRES, Nick, 2011, Vatican throws light on history as it opens secret archives. *Daily Telegraph*, 20 December 2011, page 25.

Worse than painting yourself into a corner?

A pensioner in Jena, eastern Germany, accidentally walled himself up in his own cellar. Whilst walling off an area to which he no longer wished to have access, he found when the work was completed that he was trapped behind the wall he had just built. Unable to attract attention, he remained walled up for several days before breaking out to freedom – via his neighbour's cellar, now his own!

ANON, 2010, Pensioner trying to seal off cellar bricks himself in. *The Guardian*, 26 November 2010, page 30.

Ukraine underground site in the news in the London *Metro*

A natural solution cave (in which a small part near the entrance was once worked as a mine) near Chortkiv, Ternopol Oblast, in central Ukraine, was featured in the London *Metro* recently.

Most natural solution caves are in limestone, but the very extensive Mlynki cave is one of the rare sort dissolved in gypsum rock: another example is known in Canada. Selenite (gypsum) crystals line the cave walls. The small mined section was for gypsum to manufacture plaster.

The Ukrainian caving club Speleoklub Kristal has its base in Chortkiv, and hosted a visit by Paul Sowan, Ton Breuls (Maastricht), and David Havlicek (Prague) in 1996. One or two other much smaller caves in the locality were also seen by the group, where evidence for their use as places of refuge during World War II was seen.

Solution cave systems also occur in gypsum beds in the UK, where they have been responsible for subsidence damage to buildings in East Yorkshire. However, human access has never been found to be practicable.

SOURCE: ATTEWILL, Fred, 2012, Inside a real crystal palace. *Metro*, 6 July 2012, 30–31.

Direction of Strand Underpass traffic reversed, London

The Strand Underpass is built within part of the former Kingsway tramway subway, which was 20 ft wide and allowed bi-directional flow because of the fixed rails and relatively narrow width of the trams. The new road underpass was built by John Mowlem & Co. and opened on 21 January 1964. It is only 17 ft wide, and consequently normally carries one-way northbound traffic because of the side clearances required. The headroom is only 12 ft 6 in due to the tunnel having to pass beneath the bridge abutment by a 1:12 gradient.

An electronic 'eye' alerts drivers of tall vehicles and diverts them to an 'escape route' to the left of the entrance. However, high vehicles do still try to go through and so get stuck occasionally.

The underpass is a concrete box within the former tram subway, with the road surface at the original track level. At the northern end of the underpass the road rises to the surface on a new carriageway supported by metal pillars. This passes through the site of the former Aldwych tramway station; because of the greater width requirement, 27 trees and some pavement were removed for it to be constructed.

The tunnel is used by the 521 bus route northbound. However, the direction of traffic in the tunnel has temporarily been reversed, so that it is now in use by southbound traffic. This is to facilitate easier traffic flow during the 2012 London Olympics.

SOURCE: Wikipedia, 9 July 2012.

Entrance to Strand Underpass. Photo Nick Catford

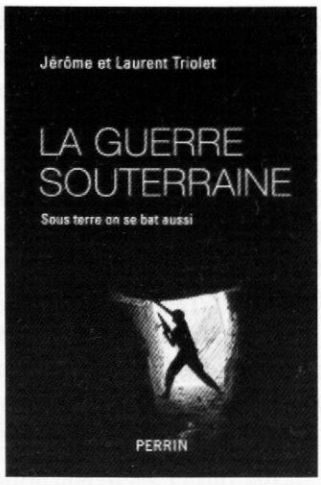
NEWS – PUBLICATIONS – BOOKS

Underground Thanet, Kent

Rod Le Gear, of the Kent Archaeological Society and the Kent Underground Research Group, has completed a study of *Underground Thanet* for the Trust for Thanet Archaeology.

The Isle of Thanet is that part of northeast Kent containing Margate, Ramsgate, etc. The geology is predominantly chalk. Rod, who is credited with being the founder of the Kent Underground Research Group, is a respected field archaeologist and the author of numerous published papers in *Archaeologia Cantiana* and the KURG *Newsletter* on chalk mines in general, deneholes in particular, and also the underground ragstone quarries at Hosey Common, near Westerham.

The book was published in June 2012. It is highly recommended, and splendidly illustrated, especially featuring Rod's measured plans and sections. Copies may be ordered (£9.99 plus £2 postage and packing) from The Trust for Thanet Archaeology, The Antoinette Centre, Quex Park, Birchington, Kent CT7 0BH.



La Guerre Souterraine [Underground War]
TRIOLET, Jérôme and Laurent, 2011
Published by Librairie Académique Perrin, 337 pp [ISBN 978-2-262-03590-7]
Reviewed by Martin Dixon

Brothers Jérôme and Laurent Triolet have been researching underground structures for over twenty-five years. Most of their work to date has covered sites in France – much of it published in *Subterranea*, the regular publication of SFES, our 'sister' French society. This new volume looks at the way in which underground space worldwide has been used in warfare.

The sites described are primarily those which have acted as shelters, with a particular focus on sites where concealment has been a key factor. Although spaces used by both civilians and the military are included, protected positions such as gun emplacements and military command centres are not generally covered. The book encompasses a wide range of periods although some eras (perhaps most notably World War II) are omitted.

Each type of site has a chapter to itself, following a timeline from eighth-century underground 'cities' in Cappadocia, Turkey to current-day examples in the Lebanon and Palestine.

The intriguing *muches* in northern France (visited on a number of Sub Brit trips) are well covered, along with more contemporary conflicts in Vietnam and Afghanistan. Nineteenth-century mining and counter-mining are well described, as are the World War I excavations of the Western Front. The ability of an underground structure to provide shelter as well as a base for attacks on the enemy are common themes. In some cases the occupants have been able to fight with great success despite their aggressors having huge technical superiority.

The book is in French throughout and its many references are again mostly but not entirely of French publications. There is unfortunately no index and the contents page is, unexpectedly for those used to English books, at the end of the volume. There are a couple of dozen or so colour photographs and some useful maps and plans.

This splendid volume is strongly recommended to those with a good grasp of French. However, for those with less fluency, we are looking at the possibility of inviting Jérôme and/or Laurent to a future Sub Brit Day Meeting, to present their fascinating research in our mother tongue.

Nottingham Suburban Railway

DETAILS: BIRCH, David G., 2010, *The story of the Nottingham Suburban Railway. Volume 1. Conception, construction, commencement*. Nottingham: Book Law Publications: iv + 92pp [ISBN 978-1-907094-98-9]; BIRCH, David G., 2012, *The story of the Nottingham Suburban Railway. Volume 2. The operational years 1889–1951*. Nottingham: Book Law Publications: iv + 124pp [ISBN 978-1-907094-36-1]

The Nottingham Suburban Railway was an independently owned three-and-three-quarter mile line including within this distance four tunnels totalling collectively over half a mile in length. The line, which opened in 1889, ran from the former Nottingham London Road station to a station at Daybrook on the Great Northern Railway, continued about three miles to the east of the city, and served suburban stations at Thorneywood, St Ann's Well, and Sherwood.

The intermediate stations were closed to passenger traffic in 1916 as a result of competition from the Great Central Railway which opened through Nottingham Victoria Station in 1900, and from the city's expanding tramways network. However, the line also served three major brickworks (one of which had access via its own tunnel) and remained in use for freight traffic until 1951.

The tunnels were all single-bore double-track. Bluebell Hill or Sneinton tunnel was 183 yards; Thorneywood or Wells tunnel 408 yards; Sherwood tunnel 147 yards; and Ashwells tunnel 70 yards. Sherwood, although short, had a double curve, so one end could not be seen from the other.

The two volumes chronicle in great detail the whole story of this very short line, including a great many photographs of the tunnels and other structures, and maps and plans. The cuttings are now mostly filled in and the tunnels blocked.

Reconstructing the realities of life and death on the Western Front in World War I

DETAILS: ROBERTSHAW, Andrew, and David KENYON, 2008, *Digging the trenches: the archaeology of the Western Front*. Barnsley: Pen & Sword: 207pp [ISBN 978-1-84415-671-9] [£25]

This illustrated hardback volume on the archaeology of the World War I trenches in Belgium and France brings to life all aspects of life and death in that theatre of war in 1914–1918.

Whereas most people's images are of 'going over the top', a cacophony of gunfire and explosions, and (for members of Subterranea Britannica) the both murderous

and suicidal digging of military mine tunnels, the archaeological evidence provides a wider and overall view informed also by historical sources. The chapter headings include: 'The trenches today', 'Digging the trenches', Living in the trenches', 'Fighting in the trenches', and 'Death in the trenches'. This is undoubtedly a recommendable volume for anybody wishing to have a wider and more balanced view of trench warfare.

NEWS – TUNNELS AND TUNNELLING

The Hackney Mole Man's former home for sale, east London

The late William Lyttle (the Hackney 'Mole Man') spent forty years digging sixty feet of tunnels underneath his house at 121 Mortimer Road, Hackney. He died in June 2010. His home was reported to be derelict and roofless in October 2011, and up for sale.

SOURCE: RAWLINSON, Kevin, 2011, For £ 500,000, the perfect place for the downwardly mobile. Kevin Rawlinson gets a viewing of the tunnels that Hackney's 'Mole Man' called home. *The Independent*, 4 October 2011, page 21.

Will the Central Line cope with the Olympic Games crowds in London?

Some 800 metres of the London Underground's Central Line were flooded between Mile End and Stratford in early June 2012, a matters of weeks before the 2012 Olympic Games were due to start at the adjoining Olympic Village.

Londoners had for some months before the event been bombarded (at their own expense) with advertising telling them that getting about London during the period of the games might be problematic as a result of overcrowding. But hundreds of passengers were trapped for two hours on trains in the tunnels when two million litres of water from a damaged 24-inch water main cascaded down a ventilation shaft into the tunnels. Eventually they were allowed off the trains and led to the nearest accessible station along the track.

'Tens of thousands' of other would-be travellers on London's Underground also experienced delays. It took some time to locate and stop the leak, pump the water out of the tunnels, and check and repair track and signalling circuits. The line was out of action for some 24 hours.

The boss at Thames Water, said to be paid £1.67 million last year for running an efficient public service, was summoned by Boris Johnson, Mayor of London, to explain himself. It has been suggested he is rather better at making money for himself and his shareholders than providing a fit-for-purpose water supply and sewerage service!

This is by no means an isolated incident for Thames Water. In 2011 another burst main, in Croydon, resulted in the main-line from London to Gatwick Airport and the south coast being blocked. And a few years ago Thames Water accidentally released a large volume of toxic chemical into the river Wandle, killing a great many fish.

Whilst an unscheduled underground walk would of course have been welcomed by Subterranea Britannica members, it is reasonable to assume it was not much appreciated by 'normal' commuters! It seems the main was fractured by persons employed by Thames Water to search for (but not to create) leaks!

SOURCES: ANON, 2012, Tube flooded in pipe burst. *Metro*, 8 June 2012, page 7; MURRAY, Dick, et al., 2012, Mayor summons Thames Water bosses to explain Tube flooding. *Evening Standard*, 8 June 2012, page 4; TOPHAM, Gwyn, 2012, Tube line to Olympic Park closed by flooding. *The Guardian*, 8 June 2012, page 13.

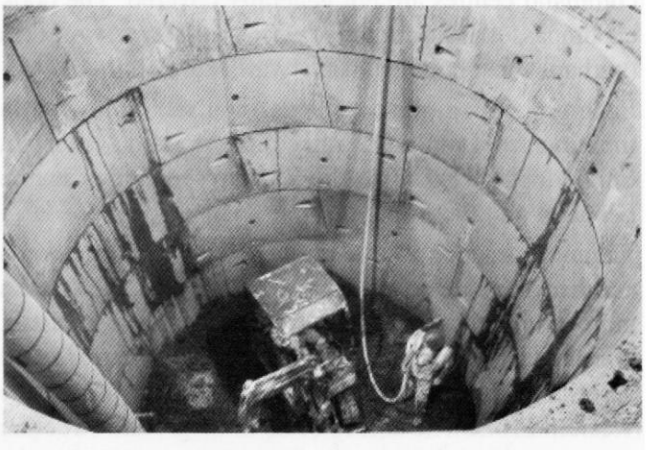
Crossrail role for Kingsway tram tunnel

The historic Kingsway tram tunnel in Holborn will be temporarily reused for Crossrail.

Crossrail's western tunnels contractor, BAM/Ferrovial/Kier, is making use of the historic central London subway, closed since 1952, to build an 8m-deep, 5m-wide, grout shaft below the floor of the tunnel.

Grout shafts allow engineers to pump grout deep into the ground to firm it and protect nearby buildings from any potential ground movement when tunnel boring machines reach the area in 2013.

The tram tunnel underneath Kingsway once took passengers from Holborn to Waterloo Bridge, providing a link between the north and south London tram networks. For the past sixty years it has been all but abandoned, given over to several uses including local authority storage, and seldom opened to the public. (The southern end, however, still serves traffic as the Strand Underpass.)



The grout shaft under construction in the floor of the Kingsway tunnel. Photo Ian Mansfield

Crossrail area director west Keith Sibley said: "The Kingsway Tram Tunnel has played a fascinating and unique role in London's transport history. Now it will play a vital part in helping prepare the ground for the city's most ambitious transport project to date. As the tunnel is a Grade II listed structure, Crossrail will return the Camden section of the tram tunnel to its prior condition when the works are completed."

London Transport Museum head of collections Martin Harrison-Putnam said: "The tram tunnel operated for less than fifty years and provided the only link between the north and south London tram networks. Opened in 1906, serving two subterranean stations at Holborn and Aldwych, the tunnel was enlarged in 1929 to accommodate double-deck trams. The pioneering decision by London County Council to construct the country's first tram tunnel was both innovative for its time and now of enduring historical importance."

The shaft will be completed later this summer before the arrival of *Phyllis* and *Ada*, Crossrail's western tunnel boring machines, in 2013.

SOURCE: *Construction News,* 11 July 2012.

Yet another tunnel under the Thames, Silvertown, east London?

The River Thames downstream from London, on account of its width and its shipping, has always been a barrier to communications between Essex and Kent. From ferries we advanced to bridges and then tunnels.

Yet another road tunnel under the river is now actively being proposed. A new Silvertown road tunnel, close to the two existing Blackwall tunnels, could give extra traffic capacity. This would run from Greenwich to Silvertown. With a capacity of 6,000 vehicles per hour such a tunnel would relieve pressure on the Blackwall and Rotherhithe road tunnels.

SOURCE: LYNCH, Declan, 2012, New Thames crossing projects edge forward after consultation. *New Civil Engineer*, 15 March 2012, page 6.

The Silvertown railway tunnel to have a new lease of life as a part of Crossrail, east London

A disused railway tunnel dating from 1878 at Silvertown, east London, is to be brought back into railway use. Two single-track tunnels in the central part of the abandoned tunnel are to be replaced by a concrete box double-track tunnel for the Crossrail branch to Woolwich Arsenal and Abbey Wood. The cited report includes a photograph taken of the interior of the old tunnel.

SOURCE: BELL, Simon, 2012, Silvertown tunnel before the Crossrail contractors moved in. *London Railway Record* 72, page 115 + inside front cover.

Tunnelling has commenced for Crossrail, London

For some while *Phyllis* has been in full view of rail travellers to and from London's Paddington Station. *Phyllis* is one of the eight Crossrail tunnel-boring machines assembled to make the several tunnels for the new cross-London subterranean railway. She is named after Phyllis Pearsall [1906–1996], the originator of the popular London A to Z street maps.

On 3 May 2012 *Phyllis* disappeared from view, having mole-like dug herself into the ground heading eastwards under Paddington main-line station on the 6.16 kilometres to Bond Street (where a new subsurface station is being added to London Underground's existing facility), thence onwards to further new subsurface stations at Tottenham Court Road, Farringdon, Liverpool Street, and Whitechapel.

Phyllis is hardly a slim young lady: she has a diameter of 7.1 metres! She is expected to reach Farringdon next year.

Meanwhile, east and southeast of central London, seven other TBMs will create other parts of Crossrail, including yet another Thames tunnel to a new sub-surface station currently under construction at Woolwich Arsenal, where a sub-surface part of the Docklands Light Railway arrived (also by tunnelling under the river) a few years ago.

SOURCE: ANON, 2012, Tunnelling gets underway: *Phyllis* sets off from Royal Oak. *Modern Railways* 69(766), 38 – 41; and Woolwich station box takes shape. *Ibid*, 46 – 49.

Box-jacking tunnel under construction at Cliffsend, Kent

A relatively new method for tunnelling under railway or road embankments without disturbing traffic above is known as box-jacking. The rectangular section reinforced concrete tunnel (floor, walls and ceiling all pre-formed as a single structure) is, for example, built on adjoining land and then pushed through the railway embankment by hydraulic jacks.

The soil being tunnelled-through is removed (via the tunnel box) as the structure advances. The method was used to take the new Coulsdon bypass on the A23 road under the Tattenham Corner branch railway line in the London Borough of Croydon a few years ago, with no interruption to train services.

One of the longest such tunnels is currently under construction at Cliffsend in Kent. A 126 metres-long underpass is being created below the new High Speed rail line on the route from London to Margate for the new East Kent Access Road. The underpass is over ten metres wide, and seven metres high.

Ways to effect this mammoth task securely are described in Margot Cole's article. A total thrust of 30,000 tonnes force is applied. Two conventional pilot tunnels through the embankment each 3.05 metres in diameter featured in the preliminary phase of the work. These were excavated in about eight weeks using conventional tunnel-boring machines.

SOURCE: COLE, Margot, 2011, Cliffsend underpass: under cover agents. *New Civil Engineer*, 15 September 2011, 18–19.

A south London tunnelling centenary: the public pedestrian subway under Norwood Junction Station

Paul W. SOWAN

When a schoolboy in South Norwood (London SE25) in the 1950s, my daily walk to 'school dinners' took me from the school buildings in Selhurst Road via a tunnel right underneath Norwood Junction station en route to a former cinema which did service as a 'Civic Restaurant' during World War II before becoming a 'dining hall' for both local technical schools.

One clear memory from this daily walk was passing the end of a very short cul-de-sac called Farley Place at the time of the death of Joseph Stalin, born Iosif Vissarionovich Dzhugashvili [1879–1953]. The whole street (eight or ten houses) was draped in black cloth and a big placard mourned the passing of the great brother and leader! At that time there was at least one Communist Party member on Croydon Council.

A second clear memory is of me and my mates charging through the subway making owl hooting noises! The centenary of the opening of this subway falls due in summer 2012, and the tunnel turns out to be of more than usual interest as pedestrian subways go.

The centenary will be celebrated by the erection of a commemorative plaque at each end, one in Station Road and the other in a public footpath link to Clifford Road.

The circular-section 97 ˚ yards (84 metres) long tunnel was driven (apparently through London Clay) below the station buildings and all seven platforms and six currently operating rail lines without interrupting train services, under powers conferred by a London, Brighton & South Coast Railway Act of 1911. The station has its own quite separate internal subway linking its platforms: this is evidently a cut-and-cover tunnel, unlike the public subway.

With its west end in Station Road, and its east end communicating with public footpaths to Carmichael Road and Clifford Road, the subway completely by-passes the station's own internal subway linking its several platforms and front and rear entrances.

The fact that it commences and terminates on public highways, and passes below railway property, means the subway was necessarily a collaborative project between the railway company and the Croydon County Borough Council. To save the cost of parliamentary fees to the Borough, the railway company added enabling clauses to an Act they were seeking anyway.

The subway was designed by George Fearnley Carter [1869–1962], the Borough Engineer at Croydon, and was innovative in that it was an early, if not the first, use of reinforced concrete as a tunnel lining. The work was done by Atkins. The deep-bored London tube tunnels from the 1890s onwards had all been lined with more expensive cast-iron segments.

In 2011 a local initiative, with Croydon Council backing, saw the commissioning of colourful murals depicting local scenes on both sides and from end to end of the subway. This added to an earlier mosaic mural alongside the pavement under the nearby Portland Road railway overbridge.

South Norwood has an industrial and transport heritage of which it can justly be proud. The inventor, industrialist and philanthropist William Ford Robinson Stanley's former factory is, in part, still standing near the station; and his Stanley Halls and adjoining Stanley Technical Trade Schools (the latter now renamed Harris Academy South Norwood) remain in use.

Hendersons had film laboratories, and C.T. Brock made fireworks nearby for some years, and there were several flourishing brickfields. South Norwood Lake, Croydon's largest expanse of open water, is the most substantial remaining evidence for the former Croydon Canal, which passed through South Norwood until taken over by the London & Croydon Railway which opened in 1839. And that railway company operated, for a few years, one of only four 'atmospheric' railways built anywhere in the world (the trains were pushed along by air pressure). Thanks to John Hickman of South Norwood for information.

ACT OF PARLIAMENT, 1911, *An Act to confer further powers on the London, Brighton and South Coast Railway to make provision with respect to the construction of a subway at Norwood Junction in the County Borough of Croydon and for other purposes* [LBSCR Act 1911] 1 & 2 Geo. V, Ch. lx: 12pp.

Proliferation of tram tunnels, Lancashire

For many years the UK's only tram tunnel (purpose-built as such) was that linking Kingsway with the Embankment in London. Initially built for single-deck trams, it was later enlarged to take double-deckers, and had two subsurface tram stops within its length. The disused Kingsway end can still be seen, a downward incline with the tramlines still in place.

More recently, additional tram tunnels have been created by adapting former conventional rail lines (and their tunnels) for light rail / tramway operation. Croydon has three, closely spaced, on the East Croydon to New Addington line.

Now there are two more, on the line from Manchester Victoria to Oldham Mumps (an odd name for a railway station!). Manchester Metrolink services were extended for public service on 13 June 2012, the route passing through Werneth and Central tunnels (separated by only very short open stretch).

SOURCE: ANON, 2012, Oldham Metrolink opens. *Modern Railways* 69(766), page 10.

An inconvenient sewer blockage at Pudsey, Yorkshire

Users of 'conveniences' at Pudsey, near Leeds, were potentially inconvenienced by a sewer blockage which restricted flow in places by 80 percent.

The problem here was not the usual sewer blockage culprit – waste cooking fat from the cheaper and nastier kinds of restaurant, where almost everything is loaded with fat, or deep fried! Fifteen metres of one of Yorkshire Water's sewers in the Yorkshire town were rendered ineffective by persons unknown illegally disposing of a large volume of wet concrete: this hardened in the 0.3 metre-diameter pipe.

The problem (and the impeded sewage) came to light as a result of basements being flooded with untreated foul water. By the time the cause of the flooding had been established, the concrete had hardened to the point where it couldn't be simply flushed away. A 170-metre stretch of road had to be closed for something like four weeks, and the blocked section of sewer dug out and replaced.

SOURCE: STIMPSON, Jo. 2011, Sewer flooded by dumped concrete. *New Civil Engineer*, 23 June 2012, page 8.

Tunnelling set to commence at Beckton Sewage Treatment Works, east London

A tunnel boring machine has been lowered into position twenty metres below ground level to form a new link in London's main sewers network, due for completion in 2014. A new 6.4km tunnel is being driven.

SOURCE: ANON, 2012, Tunnelling machine set for Beckton Sewage Works run. *New Civil Engineer*, 9 and 16 February 2012, page 9.

Reminders of the subterranean world, London

London is riddled with tunnels, all by and large safely out of sight. Only occasionally can a portal be spotted – perhaps most notably the north end of the Kingsway tram tunnel, where rails are still in situ over sixty years after the trams there last ran. But the observant will notice plenty of clues to the subterranean world.

The anonymous building, big ventilator grill, and massive crane in Furnival Street (off Holborn) near Chancery Lane tube station, for instance, is the goods lift and ventilation shaft for the former Kingway Telephone Exchange.

Several of the under-Thames tunnels can easily be spotted from boats by their stair-heads or ventilation shafts on each bank. There is a fine tunnel ventilation shaft visible from a back-street near King's Cross Station, and a weight-restriction notice indicating a tunnel below outside Liverpool Street Station. And at numerous places you can feel and hear trains rumbling underneath, such as the upstairs bar at St Pancras International, and the rooms of the Geological Society of London at Burlington House in Piccadilly,

The latest addition to the list of these reminders of underground London is provided by the new semi-circular booking hall at King's Cross Station. This is so shaped to avoid conflict with the curved façade of the adjoining Great Northern Hotel. That hotel, built in the 1850s, is itself curved to respect a bend in the culverted Fleet River below.

Late News

Tunnel collapse on the Liverpool Overhead Railway

Dozens of families were evacuated from their homes after a disused railway tunnel in Liverpool collapsed.

Fire crews were called to a garage based on Kedleston Street in Dingle around 11.30am on 24 July.

Workers at Roscoe Engineering, based in a disused railway tunnel, called emergency services when part of the roof of the tunnel collapsed. Nobody was injured and the five members of staff were evacuated safely from the tunnel which formed part of the Liverpool Overhead Railway.

Police cordoned off Park Road and nearby side streets amid fears that the tunnel collapse may cause homes to shift. More than 100 homes near the business were evacuated as a precaution. Firefighters were on scene within minutes and a building surveyor was requested.

The collapse involved an area of the roof measuring around 20 metres wide by 10 metres and around three metres thick.

Firefighters stabilised the roof and after an assessment by a structural engineer, most people were allowed back into their homes around 2.30pm.

Dingle station was once the southern terminus of the famous Liverpool Overhead Railway. Uniquely, it was the only underground station on the route, accessed through a tunnel hewn into the sandstone rock beneath the streets of back-to-back houses. The entrance to the 1896 tunnel, now blocked off, can still be seen high in the cliff face below Grafton Street, overlooking Greens health and fitness club.

Dingle station is due to be visited by members of Sub Brit as part of our autumn conference and visits weekend on 13/14 October. It is not known if this visit will now be possible.

Dingle station, the only underground station on the Liverpool Overhead Railway

SOURCE : *Liverpool Echo* 25 July 2012

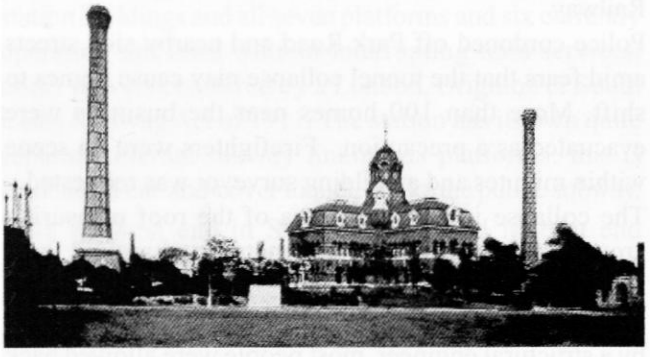
Down in London's Sewers

A special visit thanks to Thames Water

Martin Williams and Alex Lomas

In common with many of the places which fascinate members of Subterranea Britannica, London's sewers are best visited with the help of the organisation which uses and cares for them.

Each year Thames Water organises a "Sewer Week" when visitors are taken down into the sewer during a period when water levels are expected to be lower and more predictable. During this week up to three visits for around twenty people are organised each day for staff, business contacts and a few people not connected with the business. Sub Brit was lucky enough to be offered six places on a visit in May 2012 and these were allocated by ballot; this is the report of our experience.



Abbey Mills pumping station in the early years of the 20th century

We were asked to report to Abbey Mills pumping station near Stratford in east London at 5.00 pm. The weather was unseasonably wet that day and the effects of the rain will be seen later. Most of us took advantage of a free shuttle bus from West Ham Underground station. On arrival, we were struck by the immense level of security surrounding the site; not only is it instrumental in the safety of London but it immediately adjoins the Olympic site.

One can view the exterior of Abbey Mills from the Greenway footpath. This runs along the top of the grassy mound like a railway embankment which encloses the huge brick sewer pipes running on the surface of the low lying ground between Stratford and the Thames. That is normally as close as a visitor can get to the pumping station.

The twenty or so people on this trip were greeted with a good spread of food to fortify us for the next few hours, and we learned that the event would consist of three sections – a lecture on the development of London's water supply and drainage, a tour of Abbey Mills station inside and outside and finally a short ride to the place where we were to enter the sewers themselves.

The lecture and tours were led by current and retired staff of Thames Water. They were able to tell us a great deal about their subjects and were clearly proud to be spending the entire week away from their day jobs and talking to the hundreds of visitors they must encounter during Sewer Week.

Underground history

Whilst our group enjoyed the unexpected banquet there were good displays to look at showing some topics connected with our subject, such as the development of wooden and stone water pipes, and huge maps of London with the original and later sewers overlaid in different colours. There was also an opportunity to visit the archive of original drawings and specification of every detail of the construction of the sewers and pumping stations, right down to detail of individual inspection chamber covers in the street – a fascinating resource for later researches. These are now stored in the rooms that formerly housed the boilers and steam equipment at Abbey Mills.

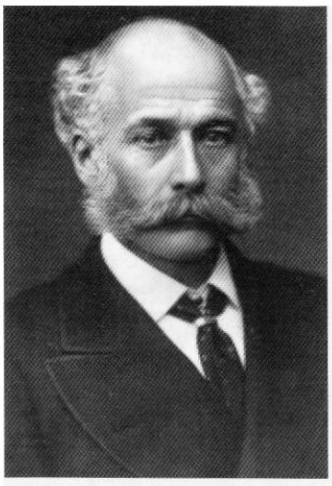
During the sixteenth century, London's freshwater supply still came from wells but it didn't take long before water started to be supplied via a series of overground pipes made from the trunks of elm trees which were then in plentiful supply in the surrounding countryside. The trunks were bored through, using the latest technology also used for cannon manufacture, and tapered at one end such that they could be joined together (hence *trunk main*). They ran above ground resting on trestles but of course leaked considerably, had a short lifespan and ran only at a very low pressure. The water supply was available only for a few hours a week and those that could afford it had to leave buckets to fill up under a trickle before it could be used.

In 1613 the New River Company was created to bring water by canal from springs in Hertfordshire all the way to New River Head in Clerkenwell, now near to Sadler's Wells Theatre. Other water companies were established throughout the sixteenth and seventeenth centuries (*e.g.* the Chelsea and Lambeth Waterworks Companies) and took their intake of fresh water directly from the tidal Thames, latterly using beam engines to pump. Over time the wooden trunk mains were replaced with cast-iron pipes through which water could be pumped at a higher pressure.

The 'Great Stink'

No sewerage facilities existed and contaminated waste water was simply run into the streets or into one of the Thames' tributaries; by the 1850s cholera was rife, culminating in the "Great Stink" of summer 1858 that almost caused Parliament to relocate. It fell to Joseph Bazalgette as Chief Engineer of the Metropolitan Board of Works to design and implement a scheme to resolve the problem.

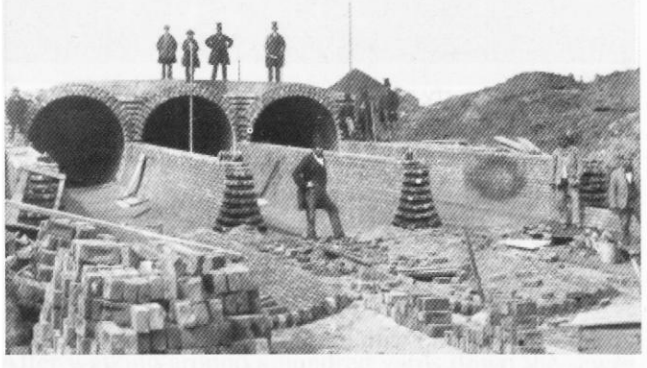
The solution involved the creation of six high- and low-level interceptor sewers running west-east across the north and south sides of London incorporating a number



Joseph Bazalgette

of 'lost' rivers such as the Tyburn. As these were gravity-fed, pumping stations were built to lift the flow at key points in Chelsea, Deptford, Crossness and of course Abbey Mills. No attempt to treat the sewage was made, and it was simply stored in lagoons at Becton and Crossness and released when the tide would not push it back towards the city.

Abbey Mills lies at the confluence of the northern interceptor sewers and lifts the flow above ground level such that it flows through the Great Northern Outflow Sewer towards Becton where it is now treated. Bazelgette's beautiful original pumping station, finished in 1868 and now known as Station A, was originally fitted with beam engines supplied with steam from coal-fired boilers.



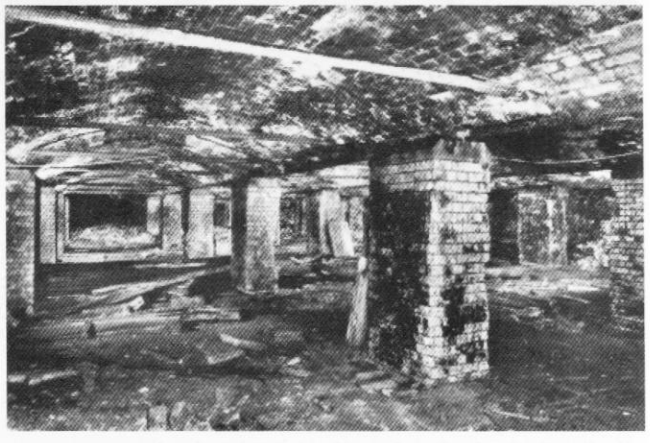
The Northern Outfall sewer during construction 1902 – 1906

The lecture reminded us of the construction of the huge and deep Ring Main under London linking all of the fresh water sources (did I see a gleam in the eye of the Sub Brit members listening – surely a step too far?) and also of the huge relief sewer proposed to run under the Thames. This will capture, store and eventually discharge to the outfalls at Crossness and Becton all of the storm water which presently overflows from the current system when there is heavy rain.

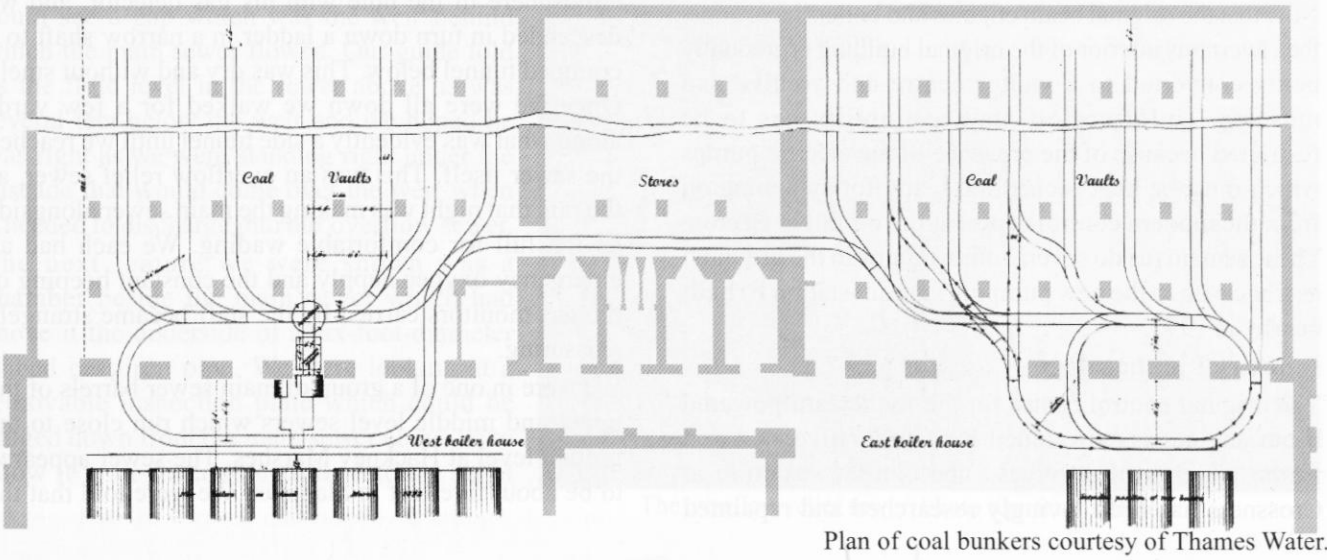
Victorian legacy

After nearly ninety minutes of lectures and questions, our party was divided into two to be guided around the inside and outside of this historic building. Opened in 1868, ten years after the Great Stink, Abbey Mills was one of the major structures intended to be the visible face of the expensive new sewer system – the others being the pumping stations at Pimlico and Crossness and the Victoria Embankment of the Thames. Despite the effects of war, technological change and periods of neglect (now over), it remains a fascinating and beautiful building.

Capacity was increased within a few years of its opening, which required other buildings to be erected in the grounds, usually to a lower architectural standard and affecting the symmetry of the original. Abbey Mills 'Station A' originally contained eight beam engines laid out as pairs in a cruciform arrangement. The underground boiler house on the northeast side housed two banks of eight boilers. These were fed from coal bunkers on the same level consisting of sixteen 100-foot bays and four 85-foot bays.



Inside the now infilled underground coal bunker.
Photo Nick Catford



Plan of coal bunkers courtesy of Thames Water.

The coal bunkers held about one thousand tons of coal and were furnished with an elaborate system of tramways over which the coal was conveyed in small trucks to the various boilers. Above the flagged top of the coal bunkers were four sets of rail lines which connected to the nearby wharf. This enabled them to discharge directly through various square apertures into the bunkers below. Due to ground instability and the deteriorating condition of the bunkers, all but two bays were infilled with foamed concrete in early 2012.

The beam engines themselves were removed in the 1930s (unlike at Crossness) and replaced with electric-powered pumps. These are now themselves listed monuments and are being carefully upgraded inside the original casings.

During World War II the two ornate chimneys, disused since 1933, were dismantled down to their bases after it was realised that a bomb landing nearby could cause them to fall and destroy the essential pumping equipment.

The base of one of the two chimneys demolished during WWII. Photo Nick Catford

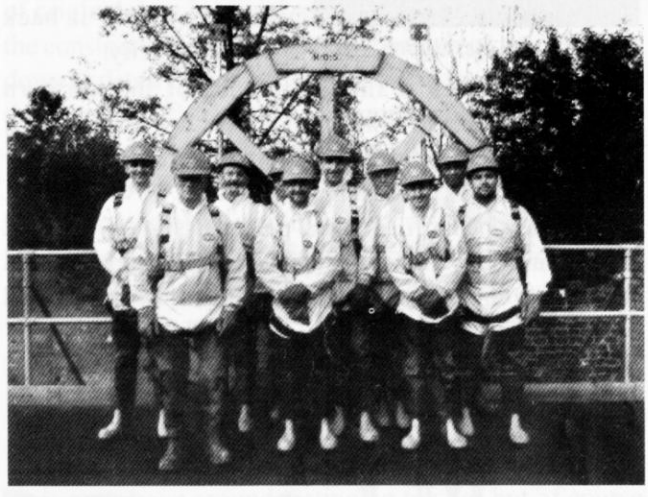
After a period of neglect and deterioration in the 1950s and 1960s Thames Water is now attempting, with the help of grants, to make the building stable and weather-tight and to clean and restore many of the key architectural features. We were proudly shown the Moorish-inspired ornate stonework and roofs, the Minton tile bands in the brickwork gleaming in the watery sun and the roof finials now back in place and regilded.

Now that the original beam engines and boilers have gone, the cavernous interior of the original building is gradually being converted to a visitor centre and archive and museum. Unfortunately its accessibility has to be restricted because of the presence of the electric pumps which must be kept secure and ready for switching on from the modern control centre at the outfall at Becton. These remain (as do several other pumps in the grounds) as a back-up to the new pumping station (station F) built nearby in 1997.

Industrial archaeology

The original control centre for the four steam-powered beam engines is surrounded by a decorative cast-iron frame which still survives. The similar structure at Crossness has been lovingly researched and repainted by volunteers. One wishes something similar could be arranged at Abbey Mills. As well as some Victorian cast-iron decoration, Abbey Mills retains the control board from the 1930s electrification with its large gauges and mimic diagrams. No longer in use, this is well preserved and adds to the considerable interest of Abbey Mills for an industrial archaeologist.

Having thus put our visit to the sewers into context, our party boarded a mini-bus and were taken out of the spacious Abbey Mills site to a working support centre for sewer examiners a few miles away. Here there were changing and washing facilities which made our visit (and our subsequent journey home) pleasant and safe.



The Sub Brit party ready for their underground adventure

We were given disposable boiler suits and two pairs of gloves, crutch-length waders, helmets and full harnesses. Somehow I had expected our entrance to the sewers would be through a door in a wall, leading to a flight of steps down to a large chamber beside a stinking flowing sewer. The reality was the opposite in all respects. Our group was lined up with our guide beside a typical cast-iron manhole cover in a path beside a garden. Above the cover was a sturdy metal frame to support the reel of a safety belt which would support us if we fell.

We get down below

The iron cover was raised, our guide checked the atmosphere in the hole with his gas detector, and we descended in turn down a ladder in a narrow shaft to a cramped tunnel below. This was dry and without smell. Once we were all down we walked for a few yards along what was evidently a side tunnel until we reached the sewer itself. This was an overflow relief sewer, as the rain that night was making the main sewer alongside us too full for comfortable wading. We each had an emergency oxygen supply and the constant beeping of the gas monitors carried by the staff became strangely reassuring.

We were in one of a group of main sewer barrels of the upper and middle level sewers which run close to the ground level at Hackney Marshes. The sewer appeared to be about five feet in diameter. We were told that the

Down we go

brickwork of the tunnel we were in was the original as laid by Bazalgette's contractors. The walls were wet with leakage of groundwater and in the bottom of the oval sewer there was about an inch of wet grit with a certain amount of other debris left where the previous flow had dropped it.

After walking around a hundred yards down the sewer we came to a series of arches in the side wall, around half the height of the sewer we were in. Crouching to get under these we found ourselves in a narrow chamber parallel to the sewer that seemed to reach for some twenty feet above us. Near to the top we could see a gap which was the weir behind which the main sewer flowed. Our guide told us the fluid level in the sewer above us was several feet below the weir and we hoped he was right as we were standing right under the cascade that would come over the weir when it needed to discharge into our overflow sewer.

The next feature we were shown was a chamber beside the main sewer which had above it the underside of a six-foot-diameter ribbed cast-iron pipe. We were looking at a removable inspection plate which could be hinged down from the main sewer above us to allow it to be diverted entirely into the relief sewer we were standing in, for maintenance and cleaning. This is another piece of the nineteenth-century construction that has stood the test of time and is still used from time to time.

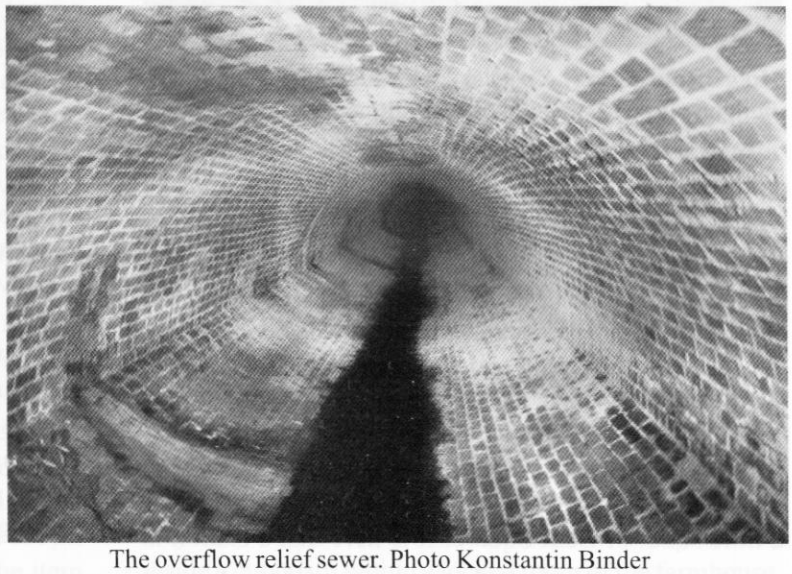
Progress was slow in the dark and slippery brick sewer and one of our party asked why we were not all given helmets with lights. Our guide explained that lights only show the surface of the soupy fluid we were walking through and it had been found that visitors unused to the conditions in the sewer managed better if they were forced to feel with their feet for the firm bottom of the sewer and any holes or steps, rather than be lulled into a sense of false security by the sight of the smooth surface of the fluid.

Daylight again

We were then ready to turn round and retrace our steps to the higher, drier end of this sewer, and eventually into the side tunnel through which we had entered. We slowly climbed the ladder, supported by the safety harness, and were grateful to reach the solid dry ground which we had left an hour earlier. Fortunately none of our party had slipped over and most of us had avoided touching the slimy walls. We each rinsed our boots in a trough of disinfectant and went back to the changing room, glad to be helped from our overalls, grimy from brushing against the sewer walls.

Although I have seen pictures of visitors to sewers in more interesting and elaborate areas, I can appreciate the problems that there would be in taking large numbers of inexperienced visitors there. The Thames Water staff who guided us and who visit sewers regularly obviously move around more easily and confidently than the visitors.

I found that what I saw was rewarding and made it easier to imagine the reality of being in a flowing sewer, and I have few regrets about being confined to the less challenging area of the overflow sewer. I am grateful that Thames Water organised such an instructive event and for the insight it has given me of London's sewers.



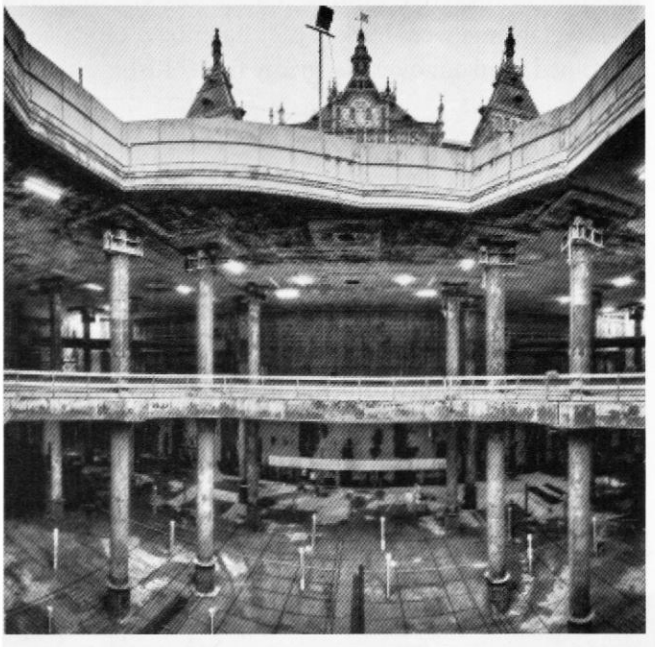
The overflow relief sewer. Photo Konstantin Binder

Amsterdam's Damned Metro

Julian Allason

Some Amsterdammers call it the "unlucky line". Others are less polite about the much delayed and grossly over-budget Metro Line 4. It should have been up and running two years ago but the latest completion date is 2017. Some question whether it will ever be completed. Such has been the public outrage over the extended delays and tax-payer-funded cost over-runs that citizens (and visitors) have been allowed to view the works – an opportunity I took advantage of at the end of October 2011.

One problem has been boring under a city built on wooden piles and which is partly below sea level. The predictable result has been subsidence of a number of historic buildings. Another difficulty relates to the hybrid metro/light rail nature of the scheme which is to share tram tracks in some areas where dual-height platforms are to be built. Then there is the question of trains having to run on both 750v DC third rail underground and on 600v DC overhead power on the tram sections. It was, needless to say, designed by committee!

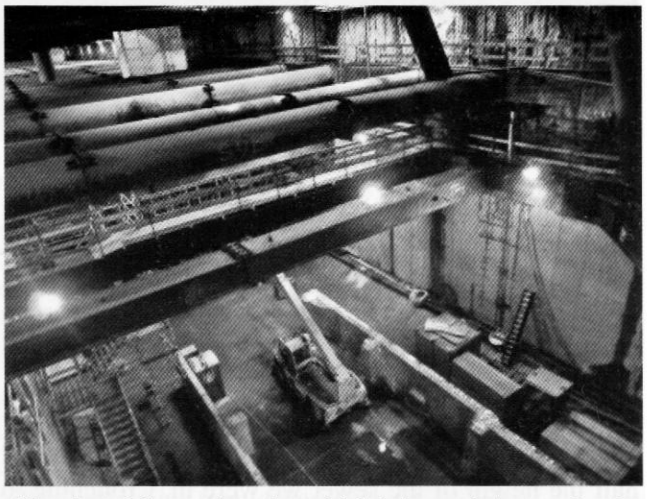


In variable geology with a sinking water table and houses built on piles construction of Metro Line 4 was never going to be easy. But subsidence to historic buildings caused during earlier excavation has necessitated a belt-and-braces approach. This picture shows early stage construction of the station at Rokin close to Dam Square. Above a U-shaped floor of reinforced concrete the rough sides of the rock can be seen to be held by a rigid steel cage braced by pipe and box girders. These will also provide floor support for station levels and underground parking.

Access to the site was gained without difficulty from a yellow-caged entrance complete with turnstile and guards in the middle of Rokin, a main thoroughfare a quarter of a mile south of Dam Square. It is here that a station is being built – very carefully for fear of the Royal Palace subsiding from view. The descent was down four storeys of temporary steel staircases to a viewing deck from which photography without flash was permitted.

It is immediately apparent where the money went: the excavation is as wide as a five-lane highway with reinforced concrete walls right up to ground level, say nine storeys high. There is frequent cross-bracing by steel pipe girders a metre or more in diameter with less frequent adjustable box girders above them. The latter are being used for gangways and to carry services.

The actual station is to be 270 metres long with platforms at a depth of 26.5m below street level – and then there is a canal just to the south to worry about. The line must dive under it without causing leakage. From ground level escalators descend to an underground booking hall and thence on down to the platforms. Underground car parking is being built above the station and the simplified plan shows vehicular access via ramps down to station level. There is also a lift shaft for goods and possibly also for disabled use.



The site of Centraal station which is beneath Amsterdam's main railway station. Here there was enough space to excavate a huge hole in the ground, whereas the Rokin a large cavity had to be excavated beneath one of the main thoroughfares without disrupting the tram route. Centraal is a junction station. Photo Julian Allason

People familiar with the project say that concern about subsidence affecting historic buildings has literally led to a belt and braces approach, one reason for the massive cost overrun. It is also noted that the water table has fallen since the project began with geological consequences that have caused revision of calculations and plans. It is evident that while the engineering is sound there is still little sense of urgency. Certainly no one was working on the Sunday I visited.

If you write the planned opening date in your diary, I strongly suggest you do so in pencil...

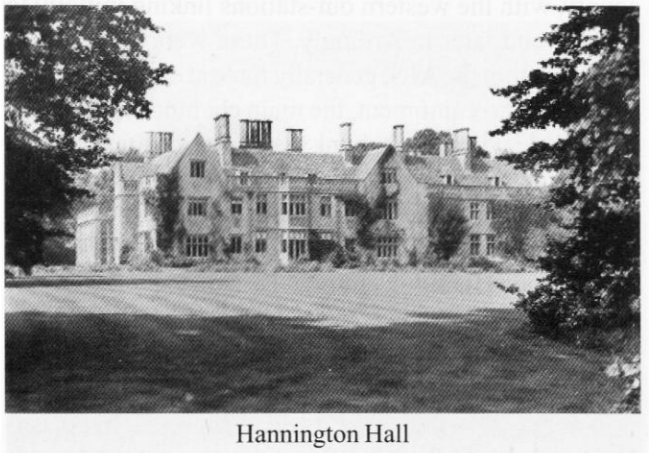
Sussex Auxiliary Units – Special Duties Section

Stewart Angell

Whilst much information has been gained about the WWII Home Guard Auxiliary Units (see *Subterranea* issues 28 and 29), there was another section formed after the sabotage side of the resistance had already been established. Known as the Special Duties Section (SDS), their top-secret role involved communications, through the use of concealed radios and spying activity. Its members were never told of the sabotage patrols in existence all around the country.

Secret Messages

The SDS headquarters was located at Hannington Hall, Hannington, Wiltshire, just five miles away from the Aux Units HQ at Coleshill House. The section's personnel consisted of spies (observers), cut-outs (runners), out-station radio operators and select members of the Auxiliary Territorial Service (ATS) who would operate the surface-positioned Control Stations (disguised as a meteorological hut), moving into the nearby underground Zero Stations (in-station) following any invasion. Both points were equipped to receive coded messages from the out-stations.



Hannington Hall

Unlike the sabotage-minded patrols, both men and women could be chosen for the task of spying. Secrecy continued to be paramount but rather than these personnel 'going to ground' they would remain integrated within their local community.

The main people recruited for this role were people whose job allowed plenty of movement around their locality – doctors, midwives, postmen, vicars and farm workers for example. These people were trained in their own areas, being taught how to make simple intelligence reports. In the event of a German invasion they would have carried on with business as usual, making reports of any German troop movements or anything else of interest they had observed.

The process of communicating this report started with an observer writing down any information gained on a piece of paper. This was then 'posted' into a designated 'Dead Letter Drop' to remain hidden, such as an old tin can or a hole in a tree. Picked up by a runner, the item would then be placed in a secret 'letter box' for the out-station radio operator to code the message for transmission. This system kept the identity of all concerned secret from each other.

Supporting the radio side were personnel from the Royal Corps of Signals. Officially they became Aux Unit Signals whose role it was to establish out-stations, maintain and repair radios, replace batteries and check aerials were securely in place.

Sussex Out-stations

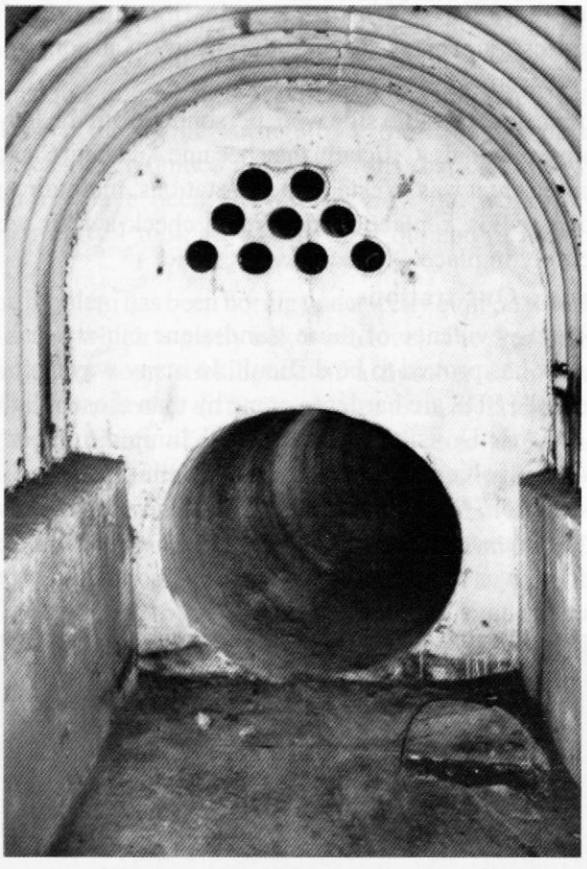
Locating evidence of these stand-alone out-stations in Sussex has proved to be difficult. In many ways details about the SDS are harder to come by than those relating to the Aux Units; this is due to the limited number of people involved, their secret roles and ultimately lack of association. With the radio operators now gone, along with the exact location or locations where radios were hidden over the years that SDS were operational, other avenues have to be relied upon.

The main chamber of the Telham out-station: a table with a radio stood in the pit. This was in a poor condition when visited in 1997 and has now collapsed. Photo Nick Catford

Having discovered the underground out-station site at Telham, near Battle in East Sussex, through a relative of the wartime radio operator in the early 1990s, it soon became apparent that it was in a poor condition. I have seen the actual site, now unfortunately collapsed completely. Its accompanying aerial tree has fallen and rotted away, a fate that has undoubtedly happened to other sites over the years.

Not all out-stations were positioned in an underground setting. Concealment within the radio operator's house or associated building is also known to have been adopted. One example of this was at Parkwood Farm, at Upper Dicker in East Sussex, where the radio was kept hidden inside a cupboard within a locked room of the farmhouse.

In 1943 the radio operator moved a few miles further south to Priory Farm at Wilmington, again concealing the radio within the farmhouse, its aerial going up the inside of the chimney.



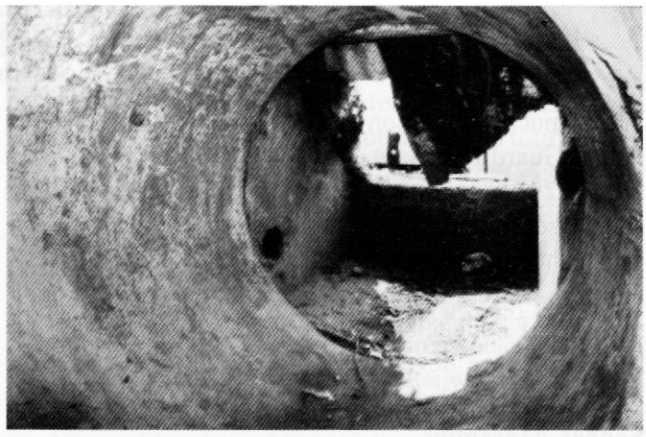
Inside the second chamber of Cadborough Out-Station looking towards the emergency exit tunnel and ventilation pipes.

Another underground out-station in East Sussex has been identified at Cadborough, near Rye. Whilst there doesn't appear to be a standard design applied to out-stations, the Cadborough site is remarkably similar to a known out-station at Cloughton, North Yorkshire, some 320 miles away!

The Cadborough out-station is constructed on a solid concrete base with all its brickwork rendered and painted white throughout. Low sidewalls support Anderson shelter-type corrugated iron sheeting along its whole length. The site has two chambers; both measuring six feet long and nearly five feet wide, divided by a narrow wall which includes a low doorway.

A vertical entrance shaft allows entry at one end into the first chamber and a three-foot-wide concrete emergency exit tunnel runs out for thirty feet from the opposite end of the second chamber. Above the start of the exit tunnel are nine four-inch-diameter glazed pipes set into the wall providing ventilation. Five other pipes, three included in the tunnel area, assist with air flow.

Two aerial feeder wires run to the outside of the out-station through an iron pipe, set into the corrugated iron near the internal dividing wall. These wires were originally concealed under the bark of an oak tree as they made their way up its trunk to the aerial/s.



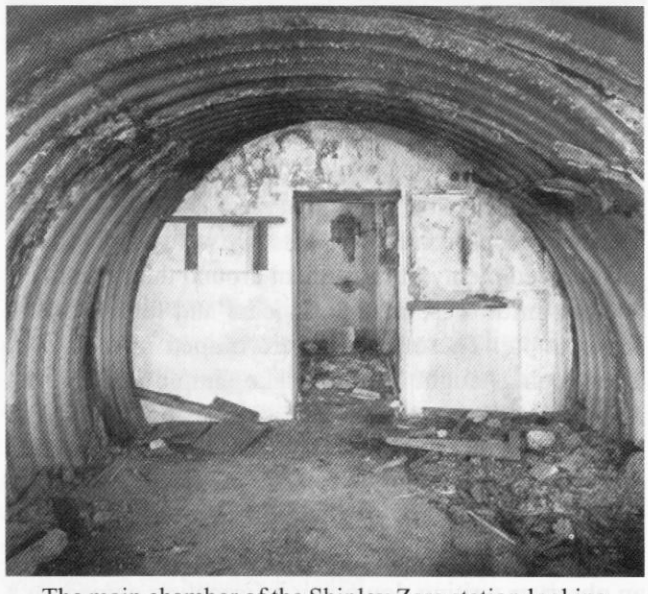
Cadborough emergency exit showing two ventilation pipes and distinct angle the hatch would have taken.

The Cadborough site is positioned in Sussex – however, the radio would have transmitted to the Hollingbourne Zero Station in Kent. Documentary evidence from a map drawn in late June 1944 shows that the Sussex radio network used a frequency of 65 megacycles and the adjacent Kent network used 60 megacycles.

Sussex Zero Stations

Sussex had three Zero Stations. These were sited in Heathfield, to cover the out-stations in the east of the county, with the western out-stations linking initially to Shipley and later to Ardingly. These were all operated by ladies from the ATS, generally three at each site. Along with the radio equipment, the main chamber contained a small table with chairs, bunk beds, spare batteries, food and water. The Zero Stations had pre-arranged times for receiving transmissions from their local out-stations. These coded messages would be passed on to a nearby Aux Signals HQ for decoding to assess the relevance of their content.

Beatrice Temple, niece of the then Archbishop of Canterbury, was appointed Senior Commanding Officer



The main chamber of the Shipley Zero station looking towards the entrance shaft. This appeared to be in good condition when visited in 1997 but by March 1999 the chamber had collapsed. Photo Nick Catford

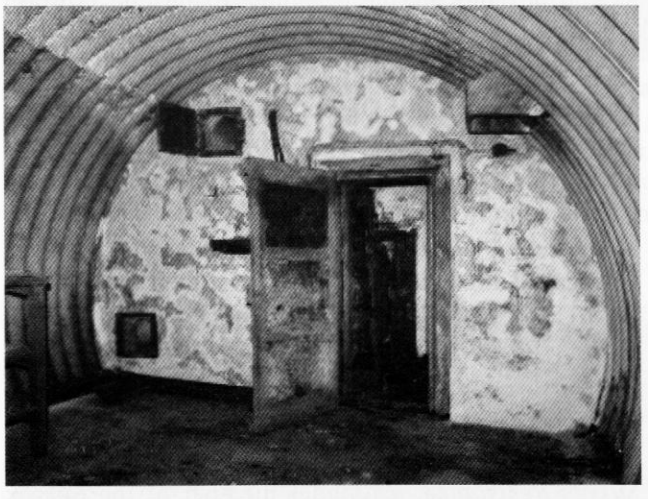
of the ATS personnel. Miss Temple noted much of her wartime activity as she made her way around the country's Zero Stations. These site visits enabled her to resolve any issues the women operatives had and to ensure that they were coping. The Sussex sites get mentioned in her notes as do the times when she decided to stay overnight at her family home in Lewes.

These notes indicate that both Heathfield and Shipley were operational by late 1941. On average Miss Temple initially visited once a month, with the frequency decreasing after she was happy with the way they were working.

At some point in 1943 Shipley was superseded by the Ardingly site. Later in that same year the Heathfield site closed down. By all accounts Sussex then continued with only one Zero Station in place until the SDS was officially stood down in July 1944. These changes of location possibly reflect the development of radios and their range over the latter stages of the radio network's existence.

Heathfield Zero Station

Many years after the war Miss Temple returned to Heathfield, assisting a local researcher to locate the exact whereabouts of the Zero Station. Despite a long search she could not locate any aspect of the former site.



Inside Heathfield Zero Station's main chamber.

In a lucky boost to my research, however, a chance conversation with a friend of mine regarding where he was working made me realize the site did in fact still exist – my friend had been repairing the sealed-up entrance shaft! Before the site was sealed again I managed to secure a brief visit. Once I was inside the main chamber it soon became apparent that the state and preservation of the Heathfield site was in far better condition than those seen elsewhere in my research.

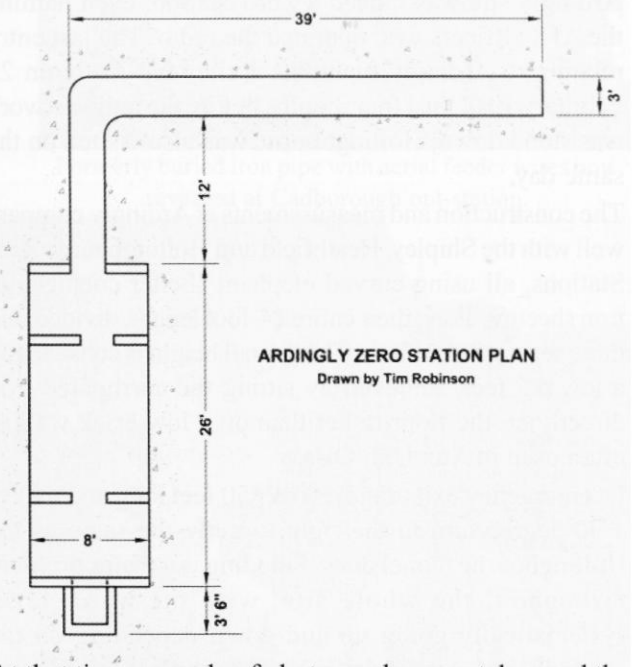
When the site was closed in November 1943, a decision must have been taken to leave an option to possibly use it again in the future, which explains why so many original features remain in place. Remarkably, the entire network of wiring still exists, the bare wires looking as if they have only just been disconnected from their fixtures and fittings. Two dividing doors still open and shut quite happily and a wooden cowling to prevent draughts from one of the main air vents remains in situ.

The emergency exit tunnel measures fifty feet long and is constructed from close-fitting three-foot-diameter precast concrete drainage pipes. However, any nearby trees that would have contained the concealed lever to open the entrance hatch, and the twin-core aerial feeder wire along with an aerial have long since gone.

Heathfield Zero Station internal door showing closing handle and locking latch. A rubber gasket surround prevented generator fumes entering the main chamber. Air handling pipes can be seen in the background.

Ardingly Zero Station

The Ardingly Zero Station, well known for being sited within the grounds of Wakehurst Place, reputedly the National Trust's most visited facility, was highlighted back in the 1970s through a magazine article written by a member of staff.



At that time a couple of photographs were taken and the site surveyed (see plan). Since then access has been denied which has led to speculation and outlandish theories relating to its use within the SDS set-up. One suggestion is the site acted as an unmanned relay station.

As a radio signal was received it would have automatically relayed the signal further inland to a Signals HQ. This process would have required many batteries to power the system and regular maintenance from Signals personnel.

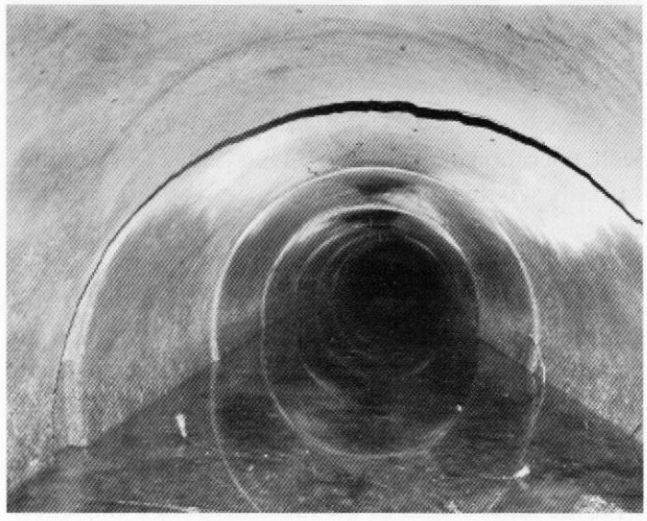
As recorded in 1975 the inside of Ardingly Zero Station showing wiring still in place and entrance shaft in background. Photo Harry Townsend

Miss Temple's wartime notes assist in clarifying that the Ardingly site was indeed a Zero Station, even naming the ATS Officers who operated the radio. The last entry relating to Ardingly mentions a site visit made on 25 February 1944, just four months before the radio network was stood down; Hollingbourne was also visited on the same day.

The construction and measurements at Ardingly compare well with the Shipley, Heathfield and Hollingbourne Zero Stations, all using curved elephant shelter corrugated-iron sheeting along their entire 24-foot length, divided into three separate chambers. The overall height is consistently a low 6 ° feet, achieved by sitting the corrugated iron directly on the floor rather than on a low brick wall as often used in Aux Unit OBs.

Its emergency exit tunnel is over 50 feet long and makes a 90-degree turn to the right, exactly the same as the Hollingbourne tunnel does. Flooding is a major problem throughout the whole site, with the water level systematically going up and down depending on the seasons but never drying up completely. This is undermining the strength and integrity of the structure which will eventually cause a collapse.

The National Trust has now fenced off the site to prevent visitors standing above the weakened corrugated iron. They have also included an interpretation board and white markers to indicate the shape of the structure below ground. This at least goes some way towards highlighting the heritage of the site.



Looking along the flooded emergency exit tunnel at Ardingly Zero Station.

Research continues

I understand others are now researching the feasibility of how the whole radio network communicated based around the radios and the technology of the time. I suspect the outcome will depend on whether anyone can build an accurate replica after all this time.

The Aux Units and SDS continue to be a fascinating subject, their past shrouded in secrecy, with little official documentary evidence available. There are still more patrols and radio sites to be discovered all around the country. Any information relating to members of an Aux Unit patrol along with the location of their Operational Base/Observation Post, any SDS radio operators and the location of their out-stations, equipment used or official documents, would be much appreciated.

Stewart Angell (Unseen.sussex@gmail.co.uk), is a long-time member of Sub Brit, author of *The Secret Sussex Resistance*, a founder member of the Sussex Military History Society (SMHS), and County Information Officer for Sussex within the National Coleshill Auxiliary Research Team (CART).

Photos Stewart Angell unless stated

References

- *The Secret Sussex Resistance* by Stewart Angell, 1996 Middleton Press ISBN 978 1 873793 82 4
- Telham Out-station – Harold Thompsett
- Cadborough Out-station – Nick Catford
- Cloughton Out-station – www.auxunits.org.uk
- Ardingly Zero Station – Harry Townsend
- Heathfield Zero Station – Stuart Bungy

Useful Websites

www.coleshillhouse.com

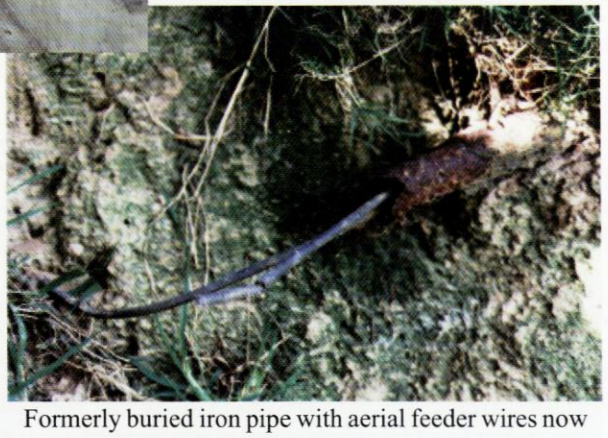
www.parhamairfieldmuseum.co.uk

www.subbrit.org.uk

WWII Aux Unit SDS underground out-station radio site at Cadborough, East Sussex

This two-chamber structure would have been divided by a door disguised as shelving. Entry into the second chamber was gained by releasing a hidden catch then pushing the shelving inwards from the base, pivoting on an iron pipe set into the walls of the doorway, the only part still in place. Ventilation piping and concrete emergency exit tunnel remain undisturbed.
Photo Nick Catford

Groove in tree indicating where the aerial feeder wire was concealed leading up to the aerial at Cadborough out-station.



Formerly buried iron pipe with aerial feeder wires now revealed at Cadborough out-station.

The entrance shaft. When in use there would have been a camouflaged hinged hatch covering the shaft.
Photo Nick Catford

The position of the angled hatch at the end of the emergency escape tunnel. Photo Nick Catford

Bidston is one of two large civilian shelters under the sandstone hills of Bidston and Tranmere in the Wirral, across the Mersey from Liverpool. Photo Chris Rayner

The site of the former Dingle Station on the Liverpool Overhead Railway. The station tunnel has been converted into a car repair workshop. A roof collapse occurred here in July 2012. Photo Nick Catford

The grout shaft under construction in the floor of the Kingsway tunnel in London during the construction of Crossrail. After completion the Grade II listed tunnel will be returned to its original condition. Photo Ian Mansfield

The lavishly decorated Yonggwang (Glory) Station on the Pyongyang Metro. Photo by Gilad Rom

The infilled west portal of the second canal tunnel at Rain Hall quarry. Photo Nick Catford

Just inside the entrance portal to the 1898 railway tunnel at St Aubin, later adapted by the Germans as Ho5. The tunnel, part of which is now a depot for bicycle hire, was converted to metre gauge by the occupiers - a section of this track is visible on the right. 60 cm-gauge track is seen on the left; this was laid into the new side storage tunnels. Photo Nick Catford

Rain Hall Rock Quarry: "Little Cut"

The history of the summit level of the Leeds and Liverpool Canal and its three major quarries

Ken Geddes

Before the opening of the Leeds and Liverpool Canal, Barnoldswick was a tiny village, mainly consisting of Town Head, which is now a conservation area. The working steam museum at the 1920-built Bancroft Mill is nearby; this was the last of thirteen mills to open in what is still a fairly small town, despite the Rolls-Royce aero engine plants and Silentnight. The Leeds and Liverpool Canal reached Barnoldswick in 1796, the 1∫ mile railway branch from the Colne–Skipton line in 1871. The railway was closed in 1985 under Beeching, but the canal is still open.

Local geology

The major structure of the Central Pennines is the Skipton–Clitheroe Anticline. This is crossed by four faults, one of which is only a few hundred yards away from Rain Hall Rock Quarry. The underlying rock of the area is Tournaisian and Viséan limestone, part of the Lower Carboniferous series. Barnoldswick lies close to the southern boundary of these rocks, with an area of Millstone Grit to the south. The local relief is formed by glacial activity, characterised by drumlins.

The canal was conceived in the 1750s and was championed by the Yorkshire woollen industry, which was well established by the mid-1700s and wanted access to the port of Liverpool for exports to the developing markets of Africa. A further goal was to access the limestone in Craven for lime-making, required for agricultural improvement and mortar for building. There was also interest from Liverpool, mainly to get cheap coal from the Wigan coalfield, although the idea of a transport link to Hull was also attractive.

The Leeds & Liverpool Canal at Gannow.
Photo Ken Geddes

The waterway was built with two tunnels on the summit level, at Gannow and Foulridge. The latter was close to the surface, but almost a mile long and at a height of 488ft. Two shorter tunnels were on the Rain Hall Rock Quarry branch.

The first sod was cut at Liverpool in November 1770 and progress north was rapid; the junction with the Douglas navigation was made in 1772. Meanwhile, work at the eastern end was also making headway and the relatively easily constructed stretch from Skipton to Bingley opened in 1773. The Bingley 5-rise locks came into use in March 1774, despite the continuation of the route into Leeds still not being fixed! By this time, 31 miles of canal in Lancashire and 23 miles in Yorkshire were completed out of the eventual 127. The canal was opened into Leeds in June 1777.

The plan proposed by the Yorkshire promoters envisaged a route which was almost direct, but necessitated an 80ft-high aqueduct over the Calder River at Whalley Nab. The Lancashire side preferred a route through Burnley and Blackburn. The Yorkshire route was finally agreed but work was stopped in 1774 because of a shortage of capital which was prolonged by the American War of Independence (1775–1783).

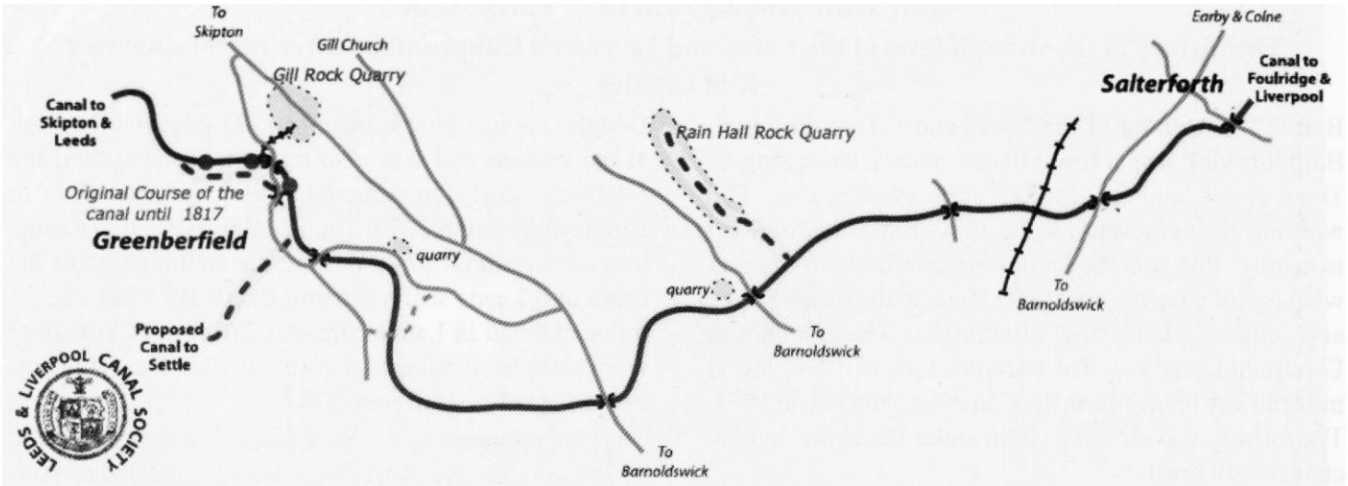
Canal mania

The stone and wheelbarrows at Whalley were subsequently removed and sent to Yorkshire to be used on the extension west from Skipton to Gargrave. Trade was now poor and costly legal problems nearly brought work to a halt in 1777. By 1782 there was a total of 75 miles of canal but no construction work, which did not recommence until more capital was raised during the "canal mania" of the 1790s.

The Liverpool–Hull connection was still the priority, but now the "Lancashire" route was adopted to pass through the rapidly growing Lancashire "coal and cotton" towns of Blackburn, Accrington, Burnley, Nelson and Colne. Construction restarted west from Gargrave in 1791. The 1,640 yards summit tunnel at Foulridge opened in 1796, but only after six years of horrendous construction problems due to unstable ground. This allowed access from the east to Burnley, where an embankment of 1,350 yards (1234m) long and up to 60ft high was needed to reach the 559 yards Gannow Tunnel.

Accrington was finally reached in 1801, but it took another nine years, until 1810, to reach Blackburn, a distance of only four miles. The need to give time for the settlement of several major embankments was one cause. The canal was still six years away from final opening through the use of the Lancaster Canal's southern section between Johnson's Hillock and Wigan.

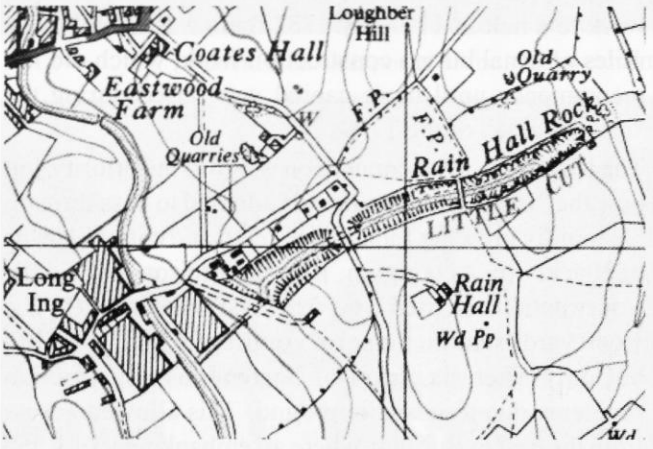
The route was finally opened throughout on 19 October 1816, but full control was not achieved until 1864. After all the setbacks and disappointments, the Leeds and Liverpool canal at 127 miles long became very successful and – despite the railways – carried 2,337,401 tons of freight in 1906 and generated £180,000 of revenue, but not quite in the way originally envisaged!



Map of part of the summit level

Competition from road and rail

Limestone had been expected to be the big traffic for short haul with the "business plan" for 1768 predicting traffic of 4,080,000 ton-miles per annum against only 840,000 ton-miles for coal. Passenger traffic in the form of fast "fly-boats" ran between Liverpool and Wigan and later long-distance services to Manchester. The canal passenger services stopped during the 1840s as the railways became faster.

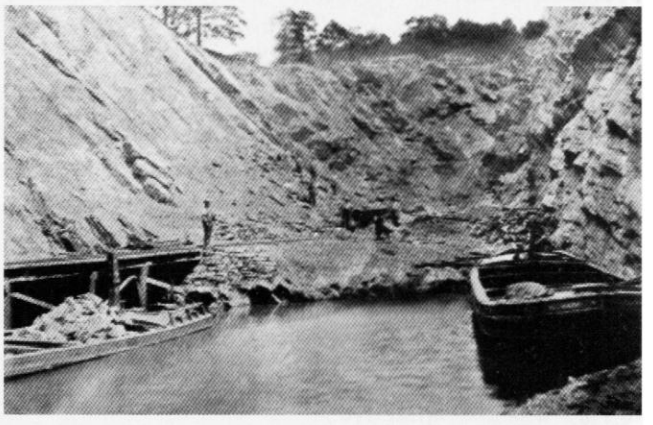


1954 1:25,000 OS map

The canal was constructed to take "short boats" of 60 ft long, 14 ft wide and 3.5 ft deep to pass through its 92 locks. This was obviously restrictive as the standard 72 ft narrow boats could not use the canal, but the shortage of water at the summit was clearly a factor in this decision. In 1822 when the Leigh branch was completed, narrow-boat traffic to and from the Bridgewater Canal could reach the Wigan coalfield and Liverpool.

Coal traffic for steam power rapidly increased in the first half-century, while building and agricultural use of lime and limestone remained static. In 1811 trade was so bad that the canal company put a charge on empty boats passing down the Greenberfield locks in the hope that they might fill up with limestone from the quarries – and use less water. Their biggest customer for the limestone was the Low Moor Ironworks at Bradford.

Overall, the canal competed successfully against the railway until after the First World War, when road traffic began to become a significant competitor. The switch from steam to diesel and electric power precipitated the end. The last load of coal from Plank Lane colliery to Wigan power station was delivered in 1972.

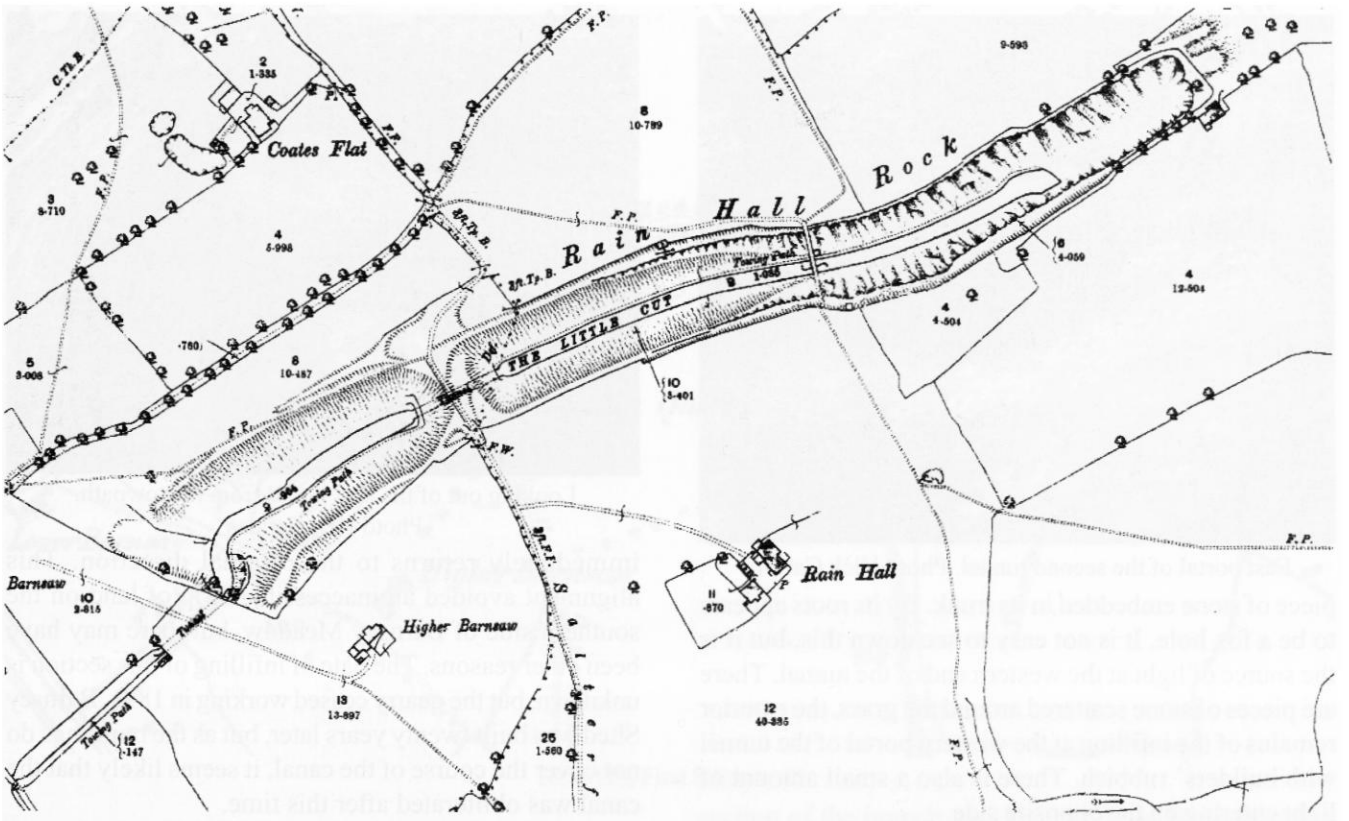


Rain Hall quarry face and loading stage

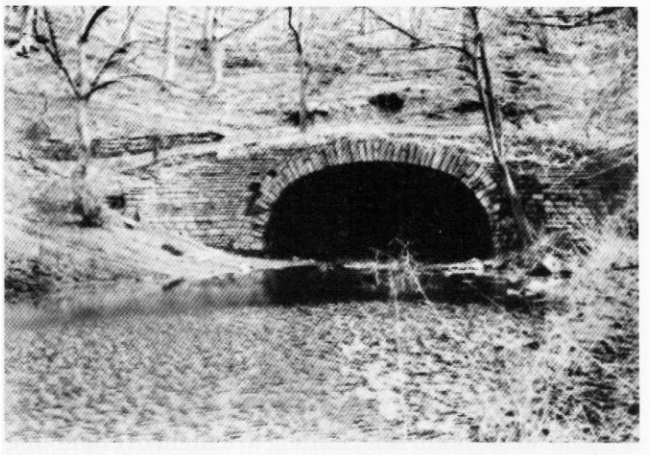
One justification for the completion of the summit level of the canal was to create limestone sales in a westerly direction from the Haw Bank quarries and also to access limestone from Rain Hall Rock Quarry at Barnoldswick and Gill Rock Quarry at Greenberfield. As soon as the canal reached Barnoldswick in 1796, engineer James Priestly was engaged to be responsible for the summit level and also to build the initial Rain Hall Rock Quarry branch, finally only 800 yards long, but with a towpath to the far side of the first of two tunnels. This was known as the "Little Cut".

The branch canal

Along the canal towpath by Long Ing Bridge (153) at Barnoldswick was Barnsey Meadow. The Rain Hall Rock Quarry branch connected with the main canal by a right-angled junction at the south end of this field. There was a bridge to take the towpath over the branch. A substantial towpath extended to the far end of the first tunnel. Now only the rounded capstones of the wall,



This 1894 1:2,500 OS map shows the branch canal three years after Rock Quarry ceased production

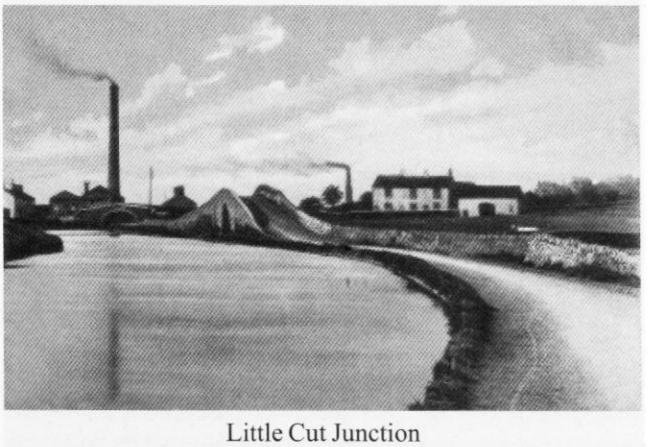


Tunnel under Salterforth Lane in 1979

originally on the bridge over the branch, can be seen. However, from the field below the capstones, an arch shape in the wall of different-sized stones is clearly visible.

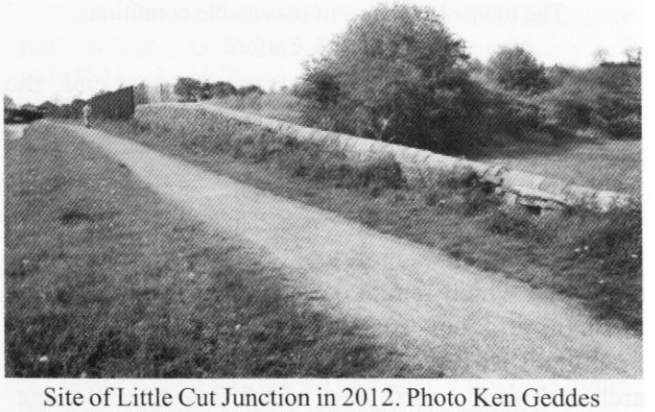
There is little evidence of the canal itself, but at certain times there is a greener shade to the grass – and the buttercups do not grow so profusely along the route! There must have been raised banking for a hundred yards or so on the towpath side because the branch traverses a shallow valley before the land rises at the filled-in and landscaped portal of the first tunnel.

Barnsey Meadow was owned by a Dr Hall while the adjacent land was owned by the Bagshawes who had quarry interests of their own and would have been less likely to cooperate. Barnsey Shed was eventually built on Barnsey Meadow, a weaving business with no looms of their own, but just providing floor area and power to individual weavers. This is now a derelict area, but had



Little Cut Junction

2,100 looms working in 1911. Its coal was delivered directly from the canal to the boiler house.



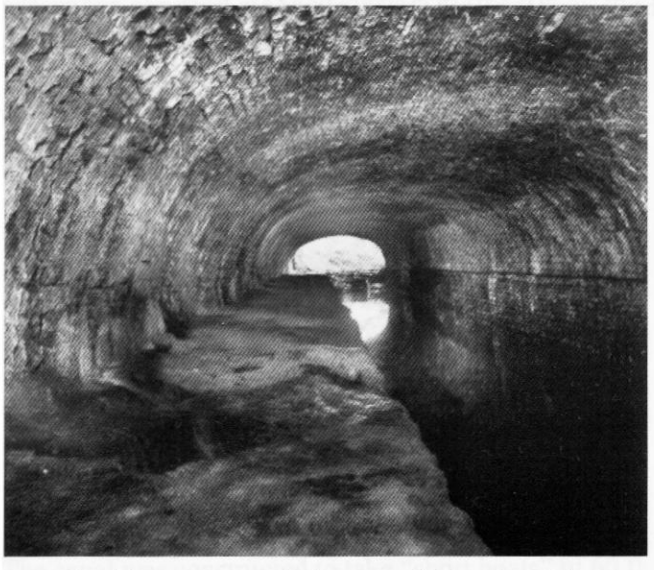
Site of Little Cut Junction in 2012. Photo Ken Geddes

Light at the end of the tunnel

East of the old weaving site, the course of the branch canal cannot be identified but up the field is a tree with a

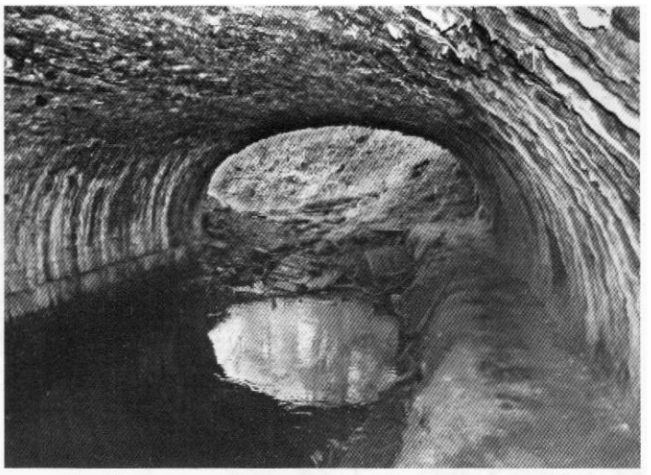
East portal of the second tunnel. Photo Nick Catford

piece of stone embedded in its trunk. By its roots appears to be a fox hole. It is not easy to see down this, but it is the source of light at the western end of the tunnel. There are pieces of stone scattered around the grass, the exterior remains of the infilling at the western portal of the tunnel with builders' rubbish. There is also a small amount of light entering on the opposite side.



Looking east towards the accessible east portal.
The towpath remains in reasonable condition.
Photo Nick Catford

Inside the tunnel, accessed from the east end, the brickwork is in sound condition, but the water level is much lower now than when working. There is a wide towpath on the south side of the tunnel, only crumbling a little towards the open entrance. The towpath here is in contrast with the Gannow and Foulridge tunnels on the main line which required "leggers" to get the boats through, although steam tugs were used latterly at Foulridge. There is no date-stone on the tunnel mouth arch and on the north side of the entrance a wedge-shaped buttress keys the masonry into the rock cutting. At this point the canal makes a 45-degree turn north and



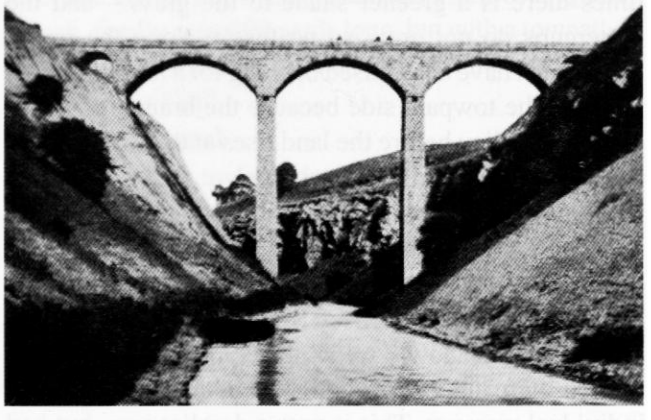
Looking out of the east portal from the towpath.
Photo Ken Geddes

immediately returns to the original direction. This alignment avoided an inaccessible strip of land on the southern side of Barnsey Meadow, but there may have been other reasons. The date of infilling of this section is unknown, but the quarry ceased working in 1891. Barnsey Shed was built twenty years later, but as the buildings do not cover the course of the canal, it seems likely that the canal was obliterated after this time.

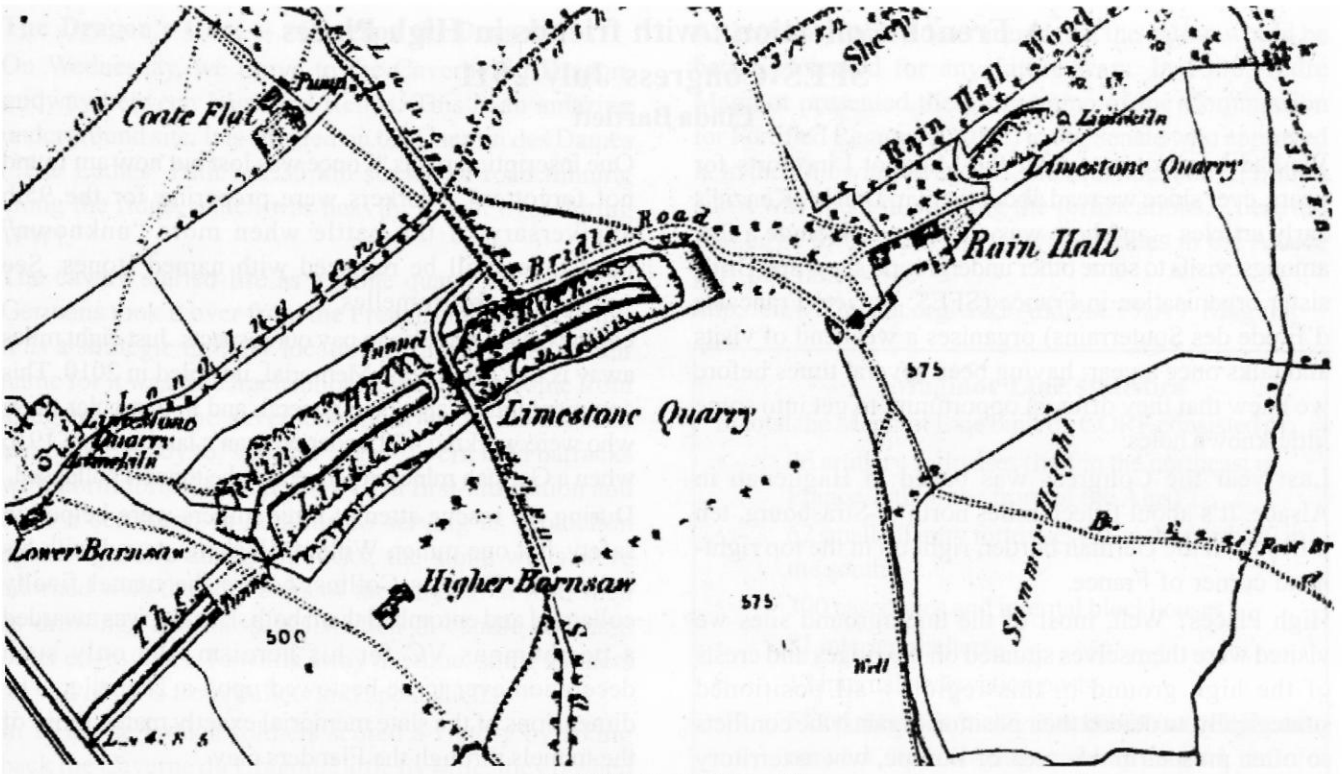
On the 1856 survey (OS, First Edition, 6") opposite, a small quarry was shown well ahead of the initial canal which was not reached until the last few years of working. It is possible that this may have been known prior to the 1790s, reassuring the canal proprietors of the quality of the limestone.

Outside the tunnel on the quarry side, there is now no sign of the towpath shown on old photographs, which appears to be just a simple path. However, the water level is correct. It is easy to walk across a concrete dam to access the tunnel mouth and towpath within.

The dam dates to the "nature reserve and fishery" project and is now covered in rocks and rubbish. However there is a path on the north side, leading to a flight of crumbling steps up to Salterforth Lane. This was an unsuccessful attempted trade-off against the c.1980s dumping of domestic rubbish into the far end of the quarry. At this point a second tunnel of similar length took the canal under Salterforth Lane and into the best rock.



Rain Hall bridge



1856 OS, First Edition, 6"

Rain Hall bridge seen from Salterforth Lane (Photo courtesy Mike Clarke). Beyond the bridge the quarry is being filled with rubbish.

The towing path crossed to the north side at this tunnel, confirming that there was no internal towpath. There was very little sideways development of the canal, the canal advancing with the working face. Because of this, the sides of the cutting are very steep on both sides.

All three stone quarries which were significant in providing trade for the summit level of the Leeds and Liverpool Canal have been closed. Gill Rock Quarry at Greenberfield finished in the late 1800s and was used for tipping of domestic waste by the local council. Rain Hall Rock Quarry ceased production in 1891 when the quarry was worked out and the lease relinquished. The far end was used for domestic rubbish in the 1980s.

The entrance to the canal branch was sold to the Barnsey Shed Co Ltd in 1922 for £100. It is not known when this section of the branch was infilled. Haw Bank Quarries at Skipton, with its long tramway down to the Springs branch, closed around 1946.

Thanks: To Mike Clarke for helpful discussions, information and photographs. His magnificent book is listed in the references; to John Dinsdale and his son Matthew of Rain Hall Farm, for very useful discussions and the loan of books, maps and photographs, also permission to explore his land; Fred Birtwhistle, owner of the existing Little Cut and the tunnel, who gave me permission to visit and photograph the existing remains; to Bob Able, Chairman of the Earby Local History Society; to Barnoldswick Library and to Nick Catford for editing and provision of a key map which answered many questions.

References

The Leeds & Liverpool Canal – A History and Guide by Mike Clarke. Carnegie Press 1990. ISBN 0 948789 40 9

Lancashire Historic Town Survey, Barnoldswick, Lancashire County Archaeology Service, 2005 (minor amendments 2006). Environment Directorate, Guild House, Preston PR1 8RD. www.lancashire.gov.uk/environment/archaeologyandheritage/historictowns/index.asp

OS 6-inch maps from 1853 and 1910 surveys.

Publications of the Yorkshire Geological Society.

Also

The Leeds & Liverpool Canal Society's website: www.llcs.org.uk

Stanley Graham's website: www.oneguyfrombarlick.co.uk . This contains photographs and extensive transcripts from interviews with local elderly residents. The original recordings are lodged in North West Sound Archive, Clitheroe Castle.

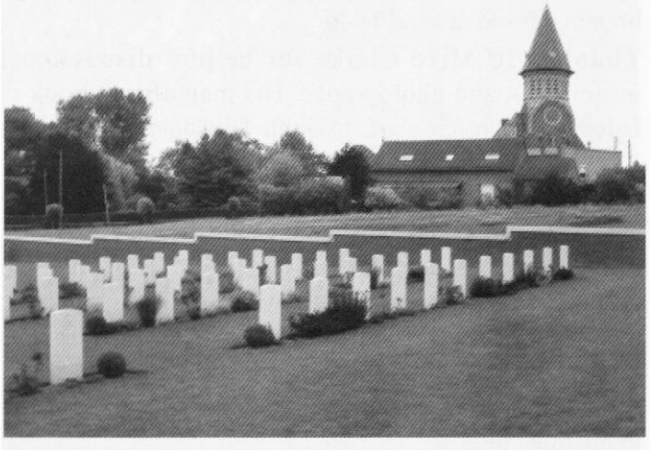
And of course: Wikipedia

A French Collection : with friends in High Places
SFES Congress July 2011
Linda Bartlett

We had been keen to visit the Maginot Line forts for years, ever since we read about them in Dan McKenzie's early articles – and here was a chance to include a few amongst visits to some other underground sites. Sub Brit's sister organisation in France (SFES: Société Francaise d'Etude des Souterrains) organises a weekend of visits and talks once a year; having been several times before we knew that they offer an opportunity to get into some little-known holes.

Last year the Congress was based in Haguenau in Alsace. It's about fifteen miles north of Strasbourg, ten miles from the German border, right up in the top right-hand corner of France.

High Places? Well, most of the underground sites we visited were themselves situated on the ridges and crests of the high ground in this region – all positioned strategically, to defend their positions against the conflicts so often present in this area of Europe, where territory has moved from German to French occupation and back again regularly during the last few centuries.



Fromelles – the first Commonwealth War Grave Cemetery to be established for over 50 years

Remembering the First World War

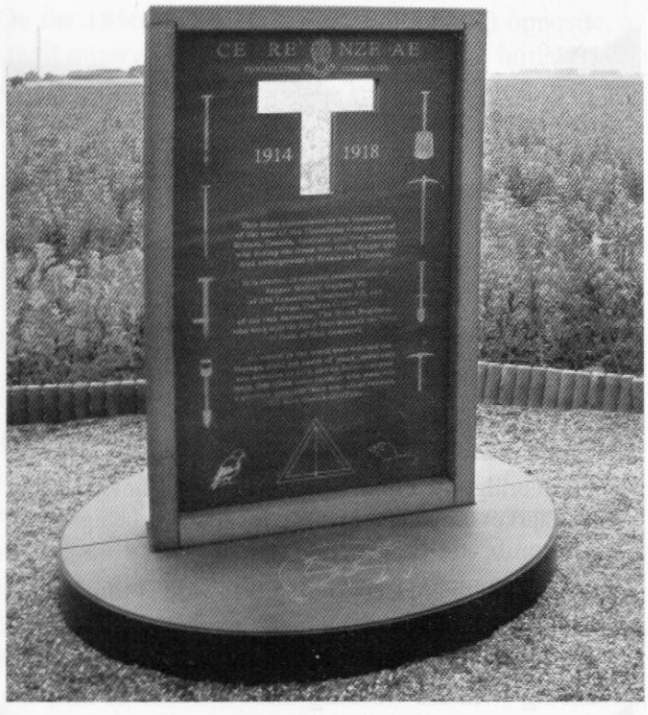
We set off on Tuesday 12 July; our first underground excursion was the Eurotunnel to France, smooth as usual, and then we headed through northern France. Our first stop was at Fromelles, a tiny village to the west of Lille. Here is the first new Commonwealth war graves cemetery for fifty years.

In July 1916 there was a disastrous battle – over 2,000 men were lost, nearly three-quarters of them Australians. Many bodies were never recovered, but in 2008 a dig was commissioned in Pheasant Wood which uncovered many remains. Now, 250 soldiers lie in the new cemetery – about one hundred of them have now been identified from DNA-matching and have named headstones. It is a peaceful, calm and very moving place, including the headstones of two brothers, now lying at rest side by side.

One inscription reads "I once was lost but now am found not forgotten". Workers were preparing for the 95th anniversary of the battle when more "unknown" headstones will be replaced with named stones. See www.cwgc.org/fromelles.

Our next stop was also to pay our respects. Just eight miles away is the Tunnellers' Memorial, unveiled in 2010. This commemorates sappers in general, and in particular those who were working 40ft under no man's land in June 1916 when a German mine exploded and the tunnels collapsed.

During the rescue attempt three miners were helped to safety, but one miner, William Hackett, stayed with his colleague, Thomas Collins, before the tunnel finally collapsed and entombed them both. Hackett was awarded a posthumous VC for his heroism, the only such decoration ever to be bestowed upon a Tunneller. The dimensions of the slate memorial exactly match those of the tunnels through the Flanders clay.



The Tunnellers' memorial at Givenchy-lès-La-Bassée

The memorial has a T-shaped hole in it (representing the tunnellers' shoulder badge), taking the visitor's gaze exactly to the site of the original shaft head close to the place in the landscape beneath which the two men still lie. See www.tunnellersmemorial.com/WilliamHackettVC.

After a sombre afternoon, we stopped for the night and cheered ourselves up in Arras, a very pleasant French town with some superb restaurants and bars – as some of you may remember from the Sub Brit French weekends.

The Dragon's Cave – "Caverne du Dragon"

On Wednesday, we drove to the Caverne du Dragon, midway between Laon and Reims. This is an amazing underground site. It is situated on the Chemin des Dames ('The Ladies' Path'), a 35 km stretch of road running along the ridge, which was heavily fought over during WWI.

The cavern started life as a stone quarry; in 1915 the Germans took it over from the French and started to use it as a strategic military location during the war – their name for it was the Drachenhöhle, thought to come from a legend about the seven entrances to the caves, each armed and ready to 'spit fire'. The Cavern held barracks with dormitories, a chapel, a well, a first-aid station and even a cemetery. In addition to serving as protection against gunfire and gas attacks, the stone walls were adorned with the souvenirs of the soldiers at rest, such as drawings and messages written in candle soot and other engravings. To while away the time, some soldiers carved objects from bullets and spent shells.

In 1917 the French soldiers scored a victory by taking back the Caverne du Dragon. Little by little, they pushed the Germans deeper into the cavern. From July to October 1917, the two enemy camps set up their internal borders, each side on constant guard against surprise attacks. See www.caverne-du-dragon.com/en.

Today, it's possible to tour the old quarries, although it's very much a managed visit as you go round on walkways, with a guide rabbiting away in French, although there are occasional panels in English. There is also supposed to be a daily English tour although the one we had expected did not materialise. It is good that you can get access to underground spaces, but our previous visit here had been much more free-roaming and gave us a better feel for what life must have been like for the soldiers cooped up here.

No more visits today, just a lot more driving to our overnight stop in St Avold. In the morning we made a quick and very damp visit to the US cemetery just outside the town. This is a massive site, some 113 acres, with the graves of nearly 10,500 men lost in WWII. We sometimes forget that fierce fighting took place all the way from the Normandy beaches to Berlin with heavy casualties on both sides. The Visitor Centre has stories of some of the men interred – again including 37 sets of brothers, 26 of them buried next to each other.

Maginot Line: Introduction

Sue Monsell had visited all the fortifications in this area a couple of weeks previously, so we are indebted to her for recommendations of which ones to visit. There is also a very good write-up in *Subterranea* Issue 2, July 2003, of forts in the Thionville area (just to the west, which we had driven through) and *Subterranea* Issue 1, January 2003, of a Sub Brit visit to forts in the Alps region.

After WWI, France determined that the nation would be better protected for any future wars. In 1930 André Maginot presented the programme of the Commission for Fortified Regions (CORF) to the Senate who approved it. In the following five years, the equivalent of 1.7 billion euros was spent in building the fortifications. There are five large forts and some forty casemates in the Alsace part of France. See http://en.wikipedia.org/wiki/Andr%C3%A9_Maginot

Maginot Line statistics

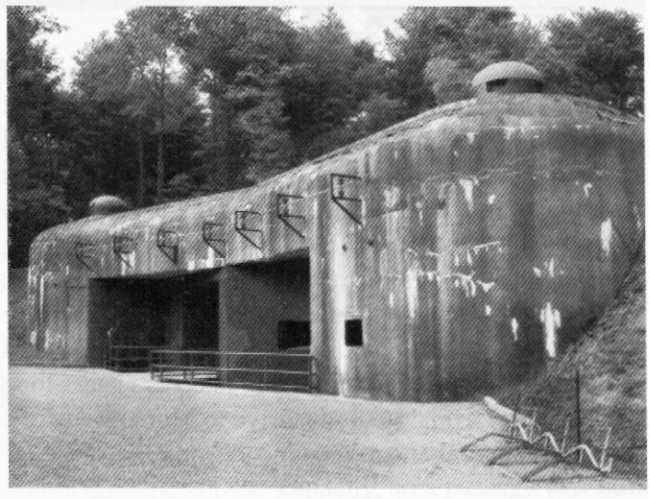
In total the Maginot Line built by CORF consisted of:

- 46 artillery fortresses (half in the northeast of France, half at the front of the Alps)
- 62 small infantry fortresses (35 in the north, 27 in the south)
- 300 casemates and internal blockhouses
- 81 internal shelters
- 17 internal observation posts
- Flood zones, barracks, an underground telephone network, narrow-gauge railway network etc.

At the beginning of WWII, Hitler chose to attack the Maginot Line here in the Alsace. The French defended well and the forts were not captured by the Germans, despite being outnumbered by about 10:1. However, in July 1940 the French troops were ordered by their High Command to hand the forts over to the German command.

Fort Schoenenbourg

We started at one of the biggest and most intact Maginot forts in this region. It's right up near the German border, the nearest village being Hunspach, in itself a remarkable place, with quaint little houses and farms. The fort has a self-guided visit, with panels in English to explain what all the rooms are and there is a useful guidebook in English. This is one of the largest works ('ouvrage') on the line – and as such is known as a Gros Ouvrage (GO).



Ammunition entrance to Fort Schoenenbourg

We entered through the old ammunition entrance, and set off to explore what must be nearly a mile of underground tunnels and rooms. The entrances are over half a mile from the ammunitions stores and gun turrets. First we visited the barracks, kitchens and generator rooms located near the men's entrance. The fort was served by 620 men, with beds for just over 150 in the barracks. It is all in very good condition, with lots of equipment on show, giving a very good idea of what it must have been like during its period of occupation.

The main kitchen at Maginot Line 'Gros Ouvrage' Fort Schoenenbourg

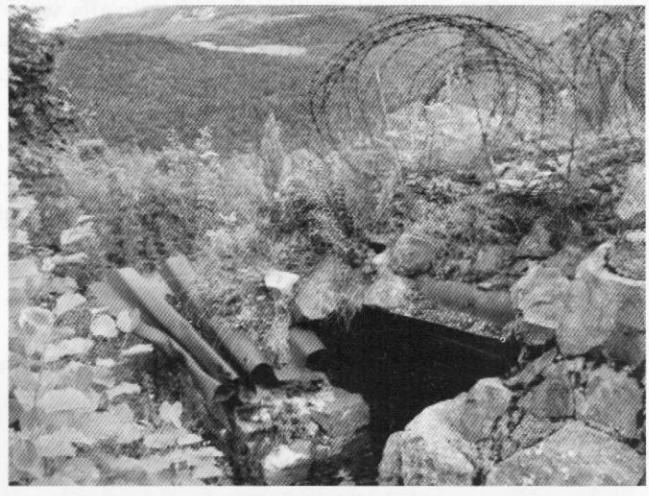
Main corridor at Fort Schoenenbourg

Then we trotted off down the long corridor to the gun turrets, passing on the way the railway which was used to move ammunition to the guns. En route we passed cable and sewer tunnels and niches to hold explosives for a 'last ditch' defence. We were able to climb up to the base of the gun turret, passing the ammo stores along the way, and a tiny room with a couple of bunks for men on duty. It was all in remarkably good order. Then we headed back into the fresh air, passing the forward command post with its offices and telecoms gear along the way. And a final (tedious) drive to Mulhouse where we were spending the night.

First World War trenches

On Friday we had the first visit of the SFES Congress. We met in a tiny village called Vieil Armand, about ten miles northwest of Mulhouse. The border is still close here and the land and governance has changed hands many times over the years between Germany and France. In fact the name of this village was once Hartmannswillerkopf – and the French gave this their own pronunciation and it turned into Vieil Armand.

We drove up a tortuous winding road, with many hairpin bends, onto the top of a ridge overlooking the broad valley of the Rhine. We met up with some of our French colleagues and our guide for the morning (and Congress organiser) Bertrand Ferrari. It was a lovely day and we trekked to the top of the ridge and began exploring.



WWI Dugout and in-situ barbed wire entanglement at Vieil Armand

Here there are the remains of numerous trench systems – all seeming as if they had been abandoned only yesterday; endless rolls of barbed wire still in situ and many small emplacements and blocks built for guns, men or utilities. Even sniper shields and steel sentry boxes are still in place. There are no roads to the top of this ridge, only tracks leading up the 2,000 feet from the valley below, many still visible and protected with trenches.

We walked down one of them, known to the men at the time as 'the Steps to the Sky'. According to Bertrand, no mules were used to transport goods to the top – only manpower. Imagine lugging all the concrete, guns, ammunition, food and water to the top over and over again whilst under fire for all the four years that the war lasted. An amazing feat.

Ownership of the ridge changed hands some eight times during the course of the war, with only twenty metres of ground being gained. Many of the dugouts and shelters have their original names still visible in German. We must have walked five or six miles through the fortifications and finally got back to the car after about five hours – in need of the beer offered at the café! All in all the site offers an incredibly well-preserved trench and dugout system and cannot be recommended enough for those with an interest in the Western Front.

SFES Congress

Saturday was the day of the Congress in a community hall in the centre of Haguenau. Luckily we are able to speak a bit of French, and Luc Stevens, the society's president was on hand to translate if we got stuck. As usual there was an interesting mix of presentations. Topics ranged from recent excavations in the well of a local mediaeval castle through to underground aspects of the current conflict in Afghanistan. Martin also spoke on the Titan silos of the USA which was well received.

Lunch was very French and very delightful – brought into the hall and served on big tables to one side. Doesn't one always have boeuf bourguinon and apple tart for lunch, with copious quantities of local white or red wine? We had more lectures in the afternoon, and then after a short break we moved to a local restaurant for dinner – fortunately this was a more modest offering as we were still full from lunch! It was a good opportunity to talk to other delegates who as well as from France had travelled from Belgium, Germany and the Netherlands.

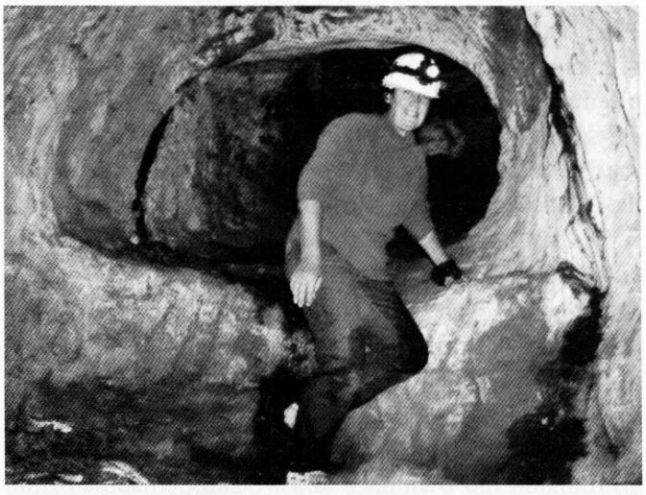
Le Château du Vieux-Windstein

Sunday morning was wet – typical that we had a lovely sunny day yesterday when we were sitting inside and a horrible day today. And we got wetter. Our first visit this morning was to an old ruined castle, set high up on a ridge again. This is in fact the same ridge as the Maginot Line – two miles to the west is Casemate Dambach, and three miles to the east is GO Four-à-Chaux.

The Chateau was constructed in the twelfth century by the Abbot Neubourg for the Emperor Hohenstaufen – as you can tell, this region was in Germany at the time. It was built to defend the route to Haguenau, where there was a palace of the emperors at the time. In about 1250 the castle fell to anti-royalists and in 1300 was taken over by two families – at this time a second keep was constructed.

Over the next years the castle saw much action, including a period of tunnelling through the rock, and it changed hands (and sides) many times. After a period of destruction it was pretty much abandoned by the fourteenth century when a new chateau was built. However, a small garrison remained in place, even after a disastrous fire in 1515. Occupation finally ended in 1676.

We scrambled up through the woods then spent an hour or so scrambling around the ruined castle, hewn out of the solid red sandstone. I say solid, but actually the exterior is now very eroded, so that walls have disappeared and some rooms are now exposed to the elements. Some rooms are (or were) underground and there is a evidence of a passage which some legends say led to the new chateau – although our guide dismissed this idea. It was quite difficult to understand what all the rooms were for, but there is no doubt that this was an impressive fortification – and amazing to be able to see some of the rooms from 800 years ago. In one room there is a well 41 metres deep cut through the solid rock.

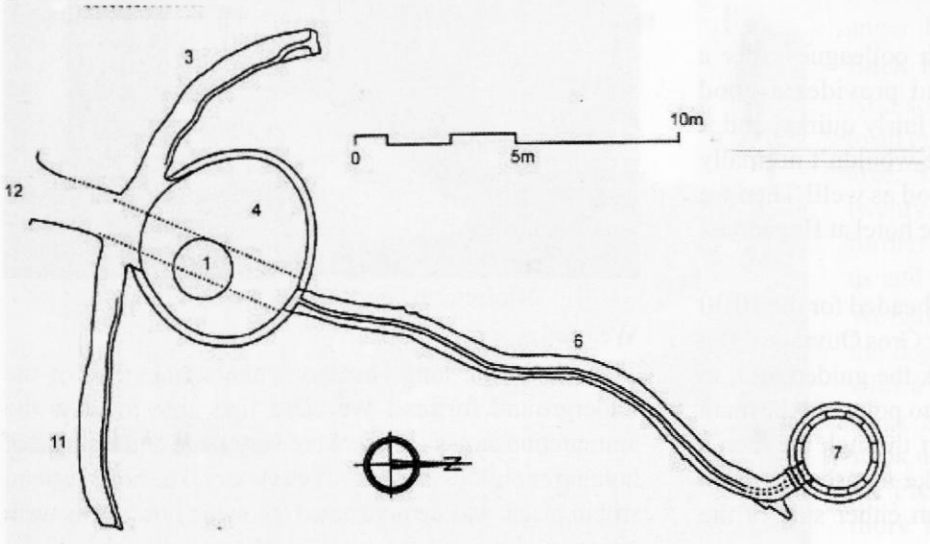


Underground 'escape tunnel' at 12th-century Château du Vieux-Windstein

Souterrain de La Petite Pierre

By now soaked to the skin, we set off in our convoy of cars in a westerly direction towards the town of La Petite Pierre. We had a wander round the ramparts of the fortified town and then headed for a gastronomic French lunch, which took a while (as they always do) making us even later in the programme for the weekend (as we always are!).

After lunch (and having dried off a bit), we visited the underground site of the town – a well/cistern, again hewn out of the local sandstone rock. When the town was constructed, they built a protected well inside the fortified walls. However, it was found that this did not supply sufficient capacity, so a passage was built to the base of the well, and at the



Plan of Petite Pierre: number 7 is the original well, 4 is the secondary reservoir, 3 and 11 are the lateral passages used to collect additional water

end of the passage they cut a circular chamber, with two additional side passages, all of which were designed to catch additional water from the aquifer and feed it into the well. It works very well at providing water, but provides a vulnerability to the town as the passage exits outside the ramparts, albeit with some protection.

Bitche Citadel

Our final visit of the Congress was to the Citadel in Bitche also along the Maginot Line near GO Simershof. This is a massive fortification constructed on another red sandstone outcrop by Vauban on the site of the old castle after the capture of Bitche by the French in 1624. It is an unusual construction for Vauban as the structure is very elongated, following as it does the natural ridge.

The fort was destroyed when it was restored to Lorraine in 1698 and subsequently restored and strengthened in 1740 into a fortress that proved impregnable in all succeeding wars. The attack upon it by the Prussians in 1793 was repulsed; in 1815 they had to be content with blockading it. During the 1870 Franco-Prussian War, the citadel was besieged for 230 days, commanded by Teyssier, who resisted the assaults of 7,000 soldiers of the Bavarian army, and three bombings. During WWI, the Citadel did not suffer hostilities, but in WWII the Allied forces' bombings of 1944–1945 caused heavy damage and in 1945 military occupation ended.

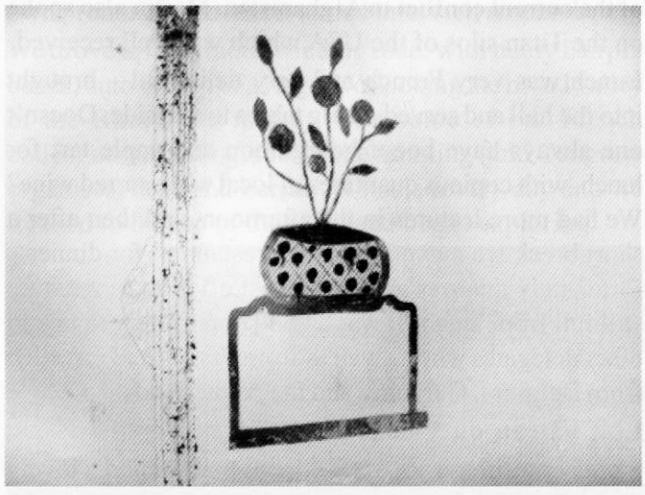
A large part of the fortification is excavated in the red sandstone rock, and was rendered bombproof; a supply of water was provided to the garrison by a deep well in the interior. The citadel is now a public site, with an audio-visual tour provided with headphones. As such, we could go round at our own pace and we skipped some of the tableaux which went into the Franco-Prussian attack in great detail. Sadly, this at times obscured visibility and access to some of the subterranean galleries, but we managed to get a good feel for the place – with one room clearly showing where horses had been stabled and others holding underground kitchens, wells and barracks.

So we said goodbye to our French colleagues after a very good Congress; the weekend provides a good mixture of site visits and talks, all fairly quirky, and it gives us a chance to visit places we wouldn't normally get to. Oh, and the food is pretty good as well! Then we headed back for our final night in the hotel at Haguenau.

More Maginot – Four-à-Chaux

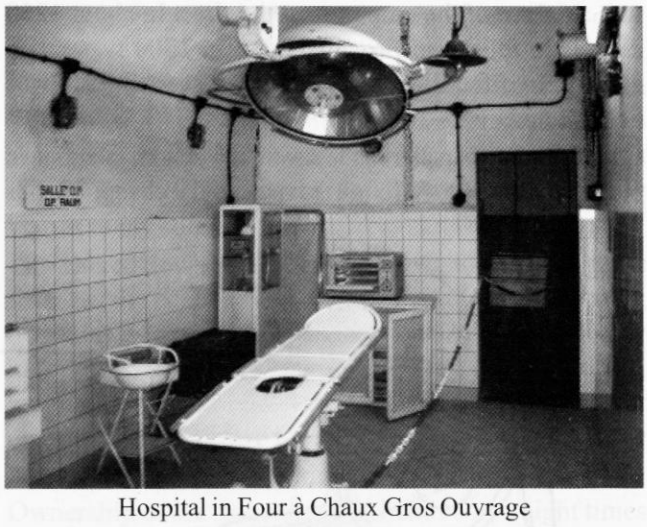
A leisurely start this morning as we headed for the 10.30 tour at Four-à-Chaux. This is another Gros Ouvrage ('Big Works') near Lembach and we took the guided tour, in French but with an English handout to point out the main sites. This time, we entered the fort through the men's entrance to the west. This looks like a casemate from the outside, with firing positions on either side of the entrance.

First up was the barracks, although we didn't get to see quite as many rooms inside this fort – but still in very good condition with many artifacts in place; also some lovely original pictures drawn on the walls by the soldiers. The toilets feature large in this fort – all constructed at a higher level, so the force of gravity helps with waste disposal. Original signs were still in place specifying the maximum size of toilet paper or newspaper to be used.



Original French graffiti in Four à Chaux Gros Ouvrage

The fort is lucky to have an artesian well supplying water which was collected in three tanks holding 50,000 litres each. Also to be seen was the emergency exit tunnel, with an ingenious trapdoor halfway up the escape shaft; this was filled with sand above (to prevent ingress by the enemy) and by a careful hinge mechanism deployed when using the shaft to escape for real, the door swung down, releasing the sand into a parallel shaft and allowing free access to the surface.



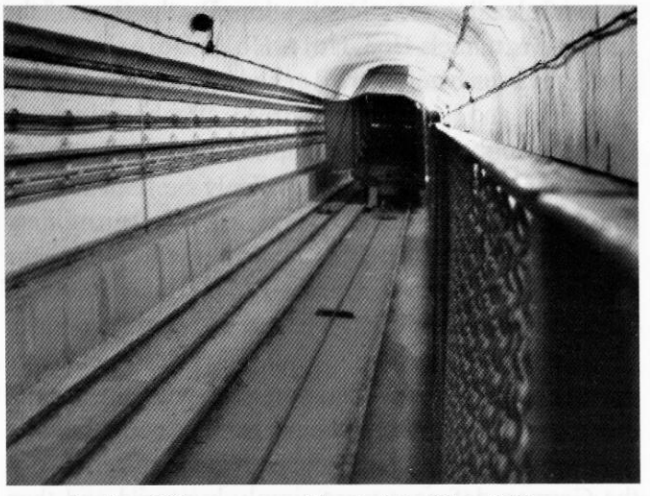
Hospital in Four à Chaux Gros Ouvrage

Weaponry

Then down the long passage to the serious end of the underground fortress. We were first able to view the ammunition stores – these were very large and capable of holding enormous amounts of weaponry. The hoist system, still in place, was demonstrated, showing how shells were transported around the tunnels. The aerial trackway has points and 'sidings' and can still be operated.

There are six gun turrets in Four-à-Chaux and the star turn in this fort was the demonstration by the guide of manually raising the 75mm gun turret in Block 2, ready for firing. This is cleverly counter-balanced as the moving parts of the turret weigh around 88 tonnes. All the mechanisms are still in place and we could have a good look round. A nice touch is a video camera set outside, so you can also watch the external view of the turret being raised.

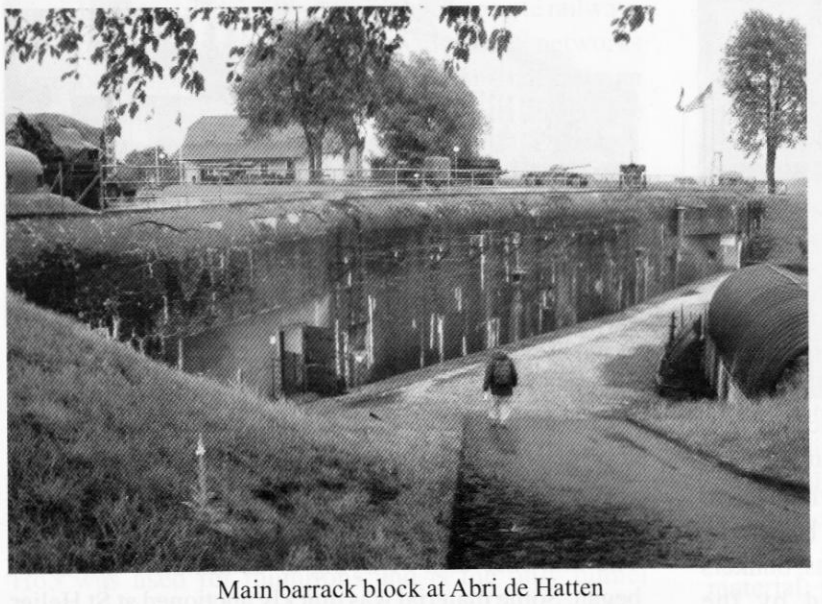
Then our return trip through the fort down the other long passage back to the ammunition entrance, with a unique feature for Maginot in this neck of the woods – an inclined plane used for hauling up the shells; this replaces the lift seen in Schoenenbourg. The rails are still in place, along with the cars used to transport the shells.



Inclined Plane ammunition hoist at Four à Chaux

Abri de Hatten – Hatten Shelter (barracks)

After a sandwich lunch (interrupted by rain) we moved on to the little village of Hatten, to visit the huge barrack block constructed here, one km behind the Maginot Line. The block was built to provide beds for 240 soldiers; it's a massive concrete construction, not fully underground, with earth banks sheltering it. The barrack block is set out as an excellent museum, and we were able to view all the rooms, by zig-zagging backwards and forwards, each room telling about a different aspect of life on the line.



Main barrack block at Abri de Hatten

The barrack block is one part of the Hatten Museum site – other exhibitions tell the story of the battle here. Hatten is again one of those towns which has alternated between German and French ownership during much of its history. The last major battle took place in January 1945.

The town had been taken without resistance by the Americans en route to Germany but Hitler mounted his last major counter-attack here – Operation Nordwind. The Colonel of the US 14th Armoured Division wrote that "... it was one of the hardest and costly battles ever fought on the western front". Around 85 percent of the town was destroyed, with over one hundred civilian casualties.

The exhibitions are very well done. There is one room with the most superb models of many of the Maginot Line fortifications, all in tremendous detail and very helpful in understanding what we saw underground.

See www.maginot-hatten.com/en.

Casemate Esch

Our last site was the small (for the Maginot Line) Casemate, just a few hundred yards from the Abri. Luckily there were a couple of men working on the Casemate and they allowed us access, as it usually has very limited opening hours.

This was again an excellent little site, set up as a museum. There are two firing positions in the Casemate, and construction is mirrored internally to reflect this. One half of the museum is set up to show how it would have looked when manned in the war, with a small barrack room, guns in their firing positions and the water tank still in place with its pump.

The other half of the museum also tells of the Battle of Hatten in 1945 and shows other artifacts, medals and so on, from the era. The building still shows the scars from its part in the action and an American M4 Sherman tank is on the roof, a position which was used in anger during the battle.

Back to reality

And so our French excursion was coming to an end. There is a lot more to visit in this area; Sue had managed to visit more than twenty Maginot sites, although some are further afield – but time was pressing for us and we had to head homewards.

We had one final night in St Avold, in one of the *Logis de France* hotels – very nice and with a lovely restaurant to round off our week away. On Tuesday we had time to stock up on wines and other delicacies from the French shops before we plunged once more into the darkness of the Channel Tunnel.

All photos by Martin Dixon.

Jersey's Underground: Sub Brit Study Tour 2012

An Island Hole-iday from the Neolithic to the Nuclear Age

Chris Jones

Friday 4 May

Jersey Airport certainly had that relaxed, but civilized, regional airport quality as we were greeted in the arrival hall by black and white photographs rather than acres of retail space.

Each year, Jersey celebrates the Liberation of the Channel Islands from the German Occupation forces of World War II – but unfortunately we would just miss this anniversary (9 May). Buses were infrequent, so it was a taxi for the drive to the Merton Hotel where we were due to rendezvous with 42 other Sub-Brit members. Our driver reckoned the misty start would lead to rain until Sunday afternoon – but does that matter if you're underground? Fellow members had arrived from far and wide – from around eight regional UK airports and Geneva and Grenada from further afield.

The German occupation of Jersey during World War II

The weekend programme concentrated on the defensive structures built during the Occupation, particularly the underground tunnel complexes. Churchill decided that the Channel Islands had very little strategic importance and were not to be defended. After evacuation provisions, Jersey surrended on 1 July 1940 but about half of the islanders stayed.

A Luftwaffe officer speaking with a British policeman in St. Helier during the German occupation

One year before the St Nazaire raid in 1942 which led to the Atlantic Wall, Hitler ordered the islands to be heavily defended. The resulting tunnels, emplacements, bunkers and surface defences were constructed by the Organisation Todt – a German military engineering group, named after its founder, Fritz Todt – which enslaved and maltreated Russians, Ukrainians, Poles, Jews and Spanish Republicans for their labour, but there were also some well-paid local contractors. As well as the gun batteries overseeing shipping, and substantial coastal defences, the scheme envisaged as many as nineteen "Ho" *Hohlgangsanlage* tunnel complexes – literally, "cave passage installations" – for protected storage and shelter from air attack.

However, by 1944, there were serious shortages of material, leading to rationalisation. By the time of the Liberation, tunnels Ho3, Ho14, Ho15, Ho16, Ho17 and Ho18 had been barely started or had stopped at the design stage. Ho6 and Ho11 were destroyed after hostilities and Ho5 is the only remaining complex that was completed.

The Channel Islands can really only be seen to have offered propaganda value to Hitler – they had no military purpose. Commanded from Guernsey after 1943, the Channel Islands garrison reached 26,000 men; 10,000 of them on Jersey. The islands absorbed some ten percent of the effort on the Atlantic Wall. The massive concrete defences to repel invaders contrast with the fragile inconveniences that would have perhaps bought a little time in England. But for all the human and material cost, the German defences were simply bypassed and then blockaded.

On 9 May 1945, the Germans on the Channel Islands surrendered, one day after the mainland German forces – although Alderney, nearer to England and even more heavily defended, wasn't liberated for another week.

The first British forces to land on the island were greeted by relieved and happy crowds in what is now known as Liberation Square. Each year the scene is re-enacted. The Pomme d'Or hotel (seen here) featured prominently in the celebrations

After surrender

The immense task of trying to demilitarise the island began. Some material was quickly auctioned at St Helier.

Much of it was stripped and burned as a desperate fuel. Bulky German equipment, including large guns, was dumped over cliffs by the Royal Engineers at Rouge Nez. Smaller materiel was moved, sometimes bulldozed, into the tunnels, including quantities of barbed wire.

Tunnel Ho1 was packed with FlaK (anti-aircraft) guns and Ho2 received small equipment and field kitchens. The French 'Char B' tanks used by the Germans went into Ho13. Eventually their contents were pillaged, authorised for scrap or later went to museums. Parts of some of the tunnels were blown in by the British and there are still beliefs that behind the precarious rockfalls could be troves of rusting German equipment. The now-mislaid Ho12 is reputed to hold motorcycle combinations.

Only four of the tunnels are used today and we had access to three of them over the weekend. On the surface, we were also to visit the sites of two large coastal batteries, some purpose-designed, heavily protected mortar and machine gun (MG) bunkers, covered passageways, the island's old civil defence centre and, to make a change from concrete, a Neolithic passage grave.

The Sub Brit trip starts

In the Merton Hotel foyer we met up with familiar faces and were introduced to John Germain, our Jersey-based Sub Brit member, who had helped this year's organiser Brian Hillman with local arrangements. We boarded a narrower-than-usual bus (to cope with the narrow Jersey lanes).

Our first stop was the St Aubin Railway Tunnel, converted during the Occupation into Ho5, on the western side of St Aubin's Bay. We arrived at the old St Aubin & La Moye Railway terminus next to the harbour. The police station is now where the train shed and main platforms used to be.

Despite its popularity, the railway was beset by repeated financial trouble. In 1936 the St Aubin terminus caught fire, burning down the train-shed roof and writing-off most of the rolling stock. The line was closed and the track lifted. But large parts of the island's two separate railways were reinstated during the Occupation; the networks were joined and a few spurs added, serving the German power station at Tesson Mill with coal, and linking the various quarries to move construction material.

On a grey day in the harbour, it looked so much easier to have gone round the escarpment rather than tunnel through it. But when the line was extended to La Moye in 1884, the frontage of the rather grand terminus was in the way. This meant building new platforms to seaward with a different track gauge and a very sharp curve inland to avoid the outcrop. In 1898, they finished this impressive 63-metre tunnel to ease the curve.

St Aubin Rail Tunnel and German Fuel store, Ho5

During the Occupation, the Germans transformed this rail tunnel into protected storage. Planned as a fuel store, Ho5 was used for munitions and is the only tunnel complex on Jersey that we can be certain was completed.

Entrance portal to the 1898 railway tunnel at St Aubin, later adapted by the Germans as Ho5. The tunnel, part of which is now a depot for bicycle hire, was converted to metre gauge by the occupiers – a section of this track is visible.
Photo Nick Catford

During the Occupation, new incoming track was laid to metre gauge. The Germans cut segmental-arched galleries to the side of the old rail tunnel. Narrow 60cm-gauge track with a drainage channel beside it led into the storage tunnels, but surprisingly, there were no turntables at the junctions with the main access tracks. A blast awning over the entrance was added and a blast wall for the harbour side. A loophole in the wall served a steel MG (*Maschinengewehr* – machine gun) platform, which partly remains.

Side passage off the main tunnel at St Aubin – constructed as Ho5. Parallel 60cm rail tracks can be made out.
Photo Adrian Armishaw

Inside, two main accesses led to angled spur tunnels. The painted tunnel numbering looked original and there were some minor electrical relics as well as many of the blast doors. At the far end of the complex, steep stairs allowed access to a concrete capping overlooking the valley behind. This served as the escape shaft and for observation. Near the top of the stairs was a standard detail of steel bars supporting loose blast protection material; these bars could only be pulled out from the

inside, and would have blocked access to the escape hatch to any attackers trying to break in from the rear.

Today's uses for the tunnels included, remarkably, the base and training track for the Jersey bobsleigh team and storage for the island's emergency stock of dog-waste bins, as well as a thriving bicycle-hire facility. The railway tunnel also stored Jersey's diesel-powered road-going train, presumably the island's version of the Strategic Reserve.

The remains of the council-owned St Aubin tunnel are now used to store the island's diesel-powered road train. Photo Adrian Armishaw

Merton Hotel

We returned to the Merton Hotel, our appetites whetted for the rest of the weekend. The hotel itself played a part in the Occupation – it was used by the Germans as a Luftwaffe hospital. We gathered later at reserved tables for the evening meal in the dining room.

The group much enjoyed the wide variety and high standard of the inexhaustible buffet – equally the friendly staff got to know our appetites, and the only practical limitation became the loss of your cutlery if an empty plate was left carelessly unattended. Much later the bar attracted the usual crowd of night owls, but unfortunately they had very little recollection to assist this report.

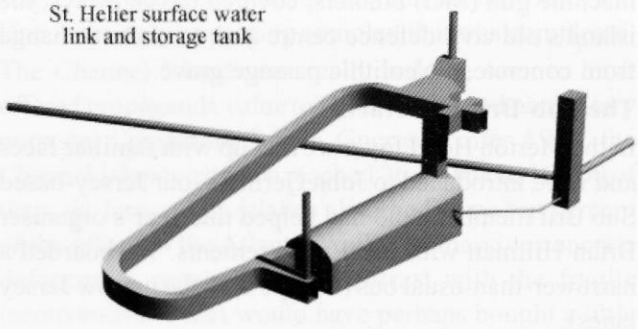
Saturday 5 May – St Helier Flood Relief Scheme

The Sub Brit visitors crowd round for a good view (and not so good smell) of the pump shaft at the storm water storage site. Photo Dom Jackson

After the excellent Merton breakfast we gathered on a different bus with Manuel, our driver for the rest of the weekend; Andy, Nick, Tony and Hugh followed behind in the pursuit car, a specially-modified Ford Focus.

Our first visit was to the impressive stormwater holding and pumping facility at Snow Hill in the centre of St Helier. Its entrance is cut into a steep rock cutting in Mont de la Ville. Around 1814, they quarried stone here to build Fort Regent, still situated above. Later the cutting was used for the 1874 terminus of the Jersey Eastern Railway and had an impressive turntable. This other line ran from St Helier to Gorey until 1929. During the Occupation, the Germans reopened this route to move construction material but after the war, both railways were quickly dismantled. We were met by Dan D'Orleans from the Transport and Technical Services Department of Jersey Water, who had given up his Saturday morning to guide us; he gave us a full safety briefing.

St. Helier surface water link and storage tank

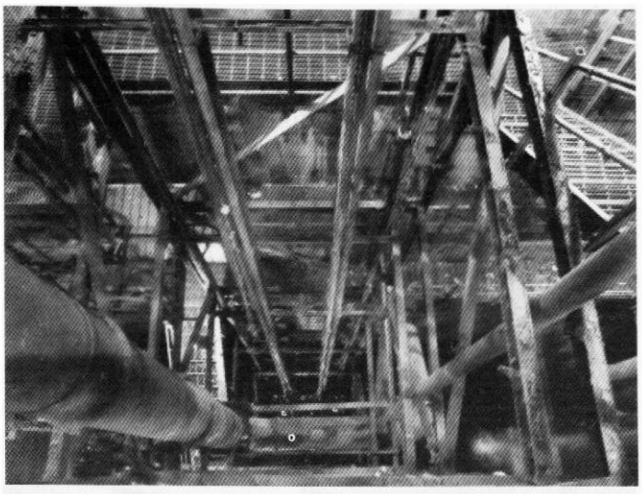


St Helier surface water link and storage tank. The main chamber of 25,000 cubic metres is in the centre and the curving access ramp can easily be seen. The 52-metre pump shaft rises out of the deep end of the cavern. The smaller circular shafts are the emergency exit (left) and ventilation extract (right). Drawn by John Higton

This project involved constructing a fully-controlled underground void for excess floodwater, likely to be contaminated with sewage, and the associated methane gas. Jersey Water is a States body and they briefed a consortium for the detailed design. As is often the case in the construction industry, the projects that attract the most attention are usually a bit late but very successful. What we see today was the most difficult engineering option considered – but it had the irresistible appeal of least-cost and was to call upon skills from the construction of the Channel Tunnel.

Involving over 1,000 linear metres of tunnelling at 3.14 and 2.74 metres diameter, these tunnels and the main cavern were formed by carefully-controlled drilling and blasting processes. Permanent stabilisation – including a major sidewall fault zone – was achieved by corrosion-protected rock reinforcement, fully integrated with the shotcrete tunnel linings.

Two segmentally-lined stormwater tunnels connect to the cavern, each containing a separate foul sewage pipe, and pass directly under the middle of St Helier. They were cut by a modified slurry Tunnel Boring Machine. There

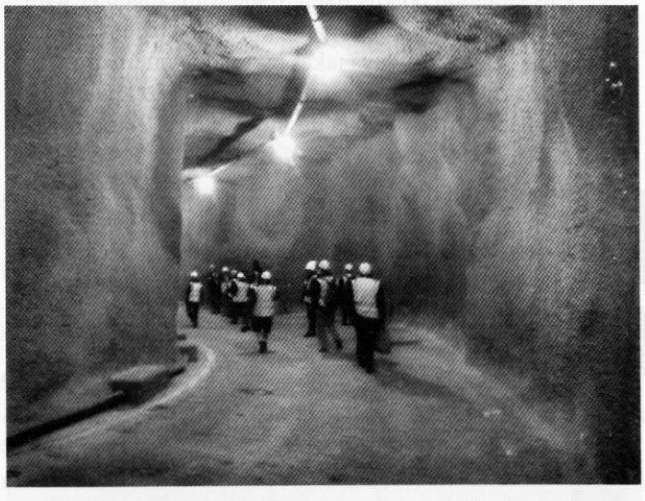


View down the 52-metre deep pump shaft at the storm water storage site. The shaft also forms the 'extract' side of the forced ventilation system. Photo Clive Penfold

was extensive monitoring of the buildings above as work progressed. To suppress dust and noise, the Snow Hill cutting with its large access shaft was covered over during the work.

Tour of the Cavern

The PPE hardhats and hi-vis went on for the tour. Just inside the entrance were a flushing tank and valve chamber plus a switch room. We were shown the carefully-designed ventilation routes through the airlock and tank, with the air-handling plant and an extensive gas detection system – the principal design concern was methane.



The inclined curving access tunnel that leads to the main storm-water storage cavern. The pipe on the left is used for water to clean the 'sludge' from the facility. Photo Clive Penfold

Nearby was the opening for the 52-metre pump shaft; we could look down but not enter. The one-tonne screw impeller pumps are hoisted on air-driven chain winches. We then walked down the steeply-sloping approach road into the storage void. All the lighting and electrical distribution here are H&S approved and are submersible. One peculiar effect when the ramp is submerged is that the water seems to be moving towards you. We were able to get the same disorienting effect by looking at the tide mark which certainly didn't look level, but that was an illusion caused by the steep slope.

Odours and noise levels were surprisingly low and there were few seepages through the concrete. Rounding the corner we found the very impressive flat-arched cavern, complete with springy gantry, well-decorated with sewage debris. At the end of the cavern is the escape shaft, 38 metres high – and narrow enough to have caused the practising fire and rescue crews with their breathing apparatus to get stuck and need rescuing. The slightly-arched cavern and approach tunnel hold 25,000 cubic metres, enough of a buffer to allow the sewage to be treated gradually following a storm.

View back towards the access tunnel from the gantry above the pump shaft. Luckily the chamber was empty, otherwise the visit could not have taken place. Photo Clive Penfold

A successful project

Corrosion needs careful monitoring. Inspections are every two years, some areas needing steeplejacks, and the original steel pipework has already been replaced with glass fibre. There was originally a wall-wash system for the cavern which the design assumed negated any reason to have dumpers on the cavern floor to remove the sludge, so the access tunnel ends at a sheer five-metre step. But the wash system failed to dislodge the accretions, so it was stripped out and Jersey Water now uses a 40kW jetwash pump fed with street water to clean the walls and they have a new desludging pump – sludge removal used to be done with shovels.

Despite going over-budget, contractual wrangling and running two years late, the St Helier Flood Relief Scheme is widely considered to be a proud achievement. In the past, mixed stormwater and sewage had overflowed into the sea, bypassing the treatment works that was unable to cope with heavy rain. Originally designed to fill every ten years, the facility actually intervenes on average twice a year. Since the cavern was commissioned in 1998 it has reduced surcharges to sea – still under Discharge Consent – by 99.4 percent and has thus been highly successful.

View of the main 25,000 cubic metre storage chamber beneath Fort Regent. The gantry leads to the sump and pumping equipment. Photo Adrian Armishaw

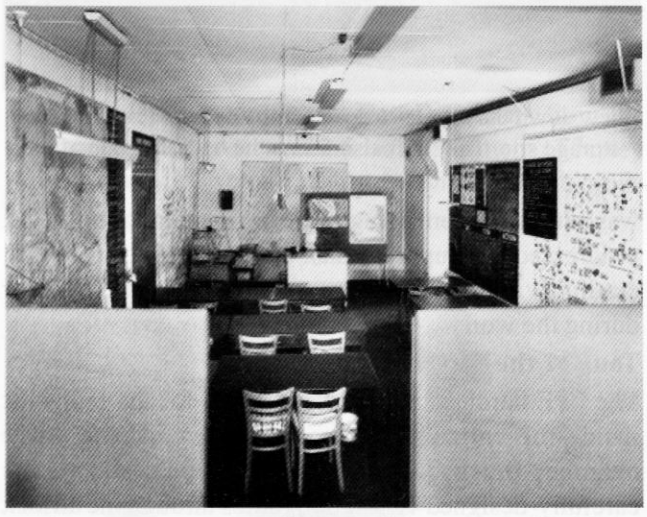
Trinity Road Civil Emergency Centre

After using the courtesy handwash station, we left for our next visit which was a short distance away to the north. Early in 1940, to improve communications with the British Expeditionary Force in France, the government installed an undersea telephone link from Fliquet Bay on Jersey. The Germans naturally reconnected this when they invaded and built this repeater station bunker to house the signal-boosting equipment.

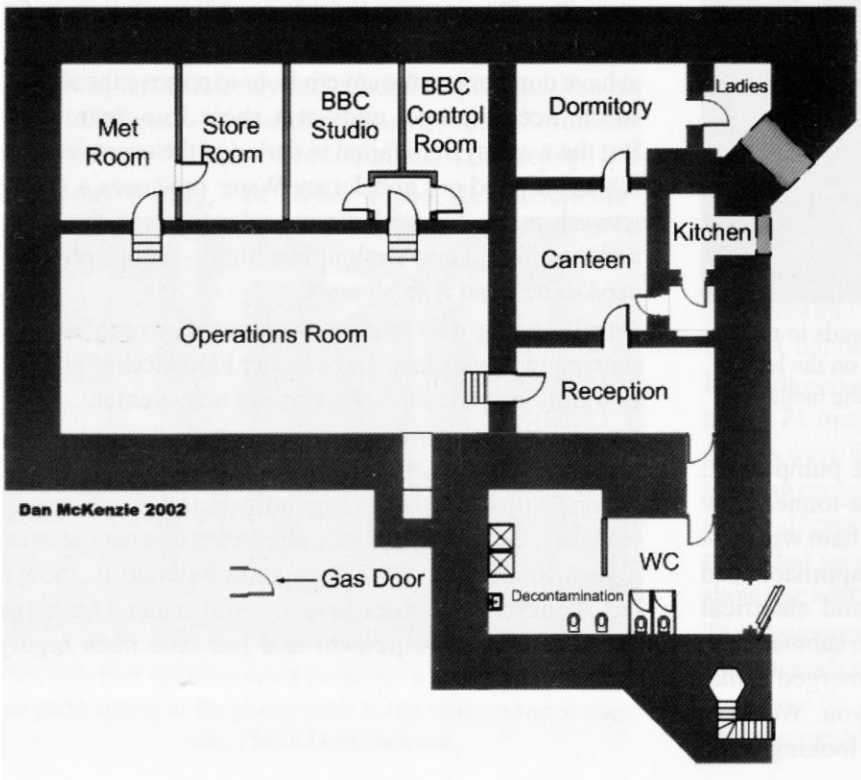
Completed in late 1944, it only worked for two months before the island was liberated. This bunker, now with a small yard, was later converted to a Civil Emergency Centre for the States of Jersey. It has since been surrounded by houses and is reached from a quiet backstreet. Just inside the door was a stack of portable mains-powered sirens, recovered from parish halls and the like. We were briefed by Michael Long with the later history.

With the end of the Cold War, the main purpose of Trinity Road was to act as a hub for three monitoring stations overseeing the risk of cross-border fallout from the nuclear power stations in France, and to manage terrorist threats. The nearest nuclear plant is Cap de la Hague about 40km away.

Remarkably, nuclear monitoring was by volunteers until it was automated in 2007, when the centre also lost its Civil Emergency function. Contrasting with the postwar zeal to obliterate structures from the Occupation, Trinity Road does now have Jersey Heritage protection.



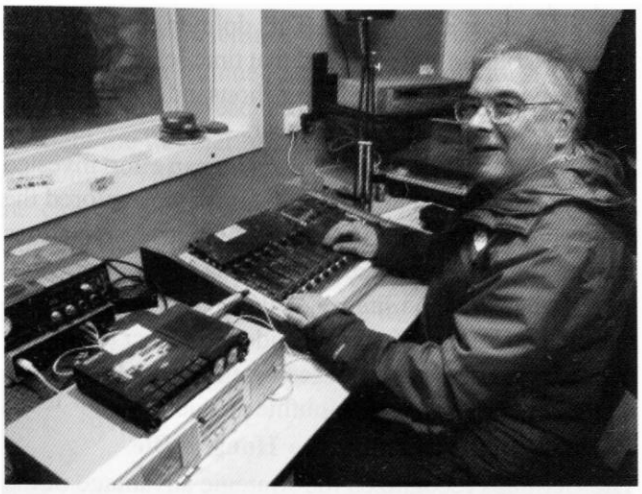
The operations room. The back of the room (behind the photographer) has been partitioned off forming a small signals area with acoustic booths and telephones. There are various situation boards fixed to the walls together with local and regional maps depicting the most recent INTEX exercise. Jersey always takes part in the international exercises. There are also details of red and black warnings. At the back of the room is the siren control equipment. Photo Nick Catford



The site record on the Sub Brit website is extremely thorough in discussing Trinity Road's emergency centre role and equipment. The bunker has been well-preserved and restored – the BBC Control Room and Broadcast Studio frozen in time with old but solid equipment, all workable but redundant and complete with a BBC clock. We learned that in a civil emergency, the populace would have heard records like *Sing-Along Christmas*, Duke Ellington, *The Sound of the Seashore* and other classics. Beside the studio was a teleprinter room with electrical equipment dating from the early 1980s.

Civil Emergency equipment

The bunker had a comprehensive archive room, with lever-arch files full of briefings on everything from how to choose and equip a fallout room to



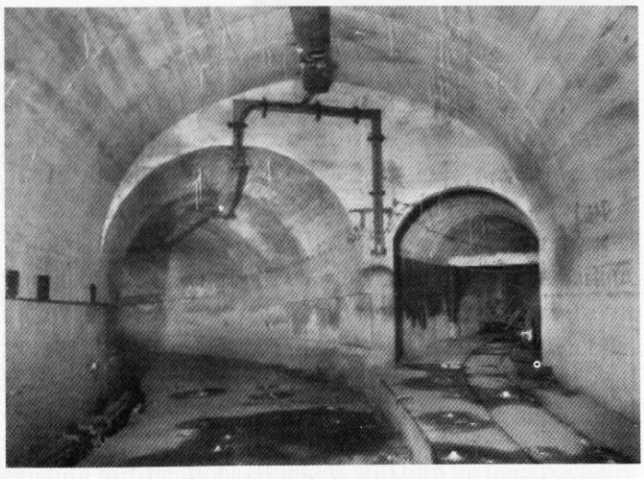
BBC engineer Bob Clary feels at home sitting at the Audix mixing desk. A Technics SP1200 record deck is seen to the right. A Sony professional cassette recorder is seen to the left and behind it a UHER reel to reel portable tape recorder. This equipment is common to all RGHQs in the UK. Photo Clive Penfold

committee responsibilities. There was very little dust around. The supply ductwork was particularly elegant with pleasingly swept bends outside the BBC Rooms – not like today's seamed and flanged material. There were old but top-quality heating controls in perfect condition.

The stores were full of useful equipment, all standard, including Geiger counters, cooking equipment, jerrycans, dosimeters and NBC gear. The Sub Brit visitors looked enviously at some of this equipment! The front of the bunker stored ancient parcels of documents that had arrived "By Fast Goods Train", including motor-fuel ration applications. Another leaflet reminded farmers to "Milk the cows" as a priority before taking shelter!

"Waterworks" munitions store, Ho4

Moving north again, on arrival at tunnel Ho4 we were greeted by the Managing Director of Jersey Water, Howard Snowden. Originally constructed for rations but used for ammunition storage, after the war the tunnels were packed by bulldozers with redundant material which blocked one of the two entrances. The grid of round-arched storage tunnels and a sealed spur lie behind the loop with a loading dock where the floor level is lower to facilitate easier transfer of goods. The escape shaft right at the furthest extent is no longer usable. The tunnels are now considered a Confined Space because they have only one entrance/exit and lack through-ventilation.



Loading dock within the Ho4 complex. 60cm track can be seen leading into the side tunnel. Writing on the wall dates from later use as storage by Jersey Water. Photo Adrian Armishaw

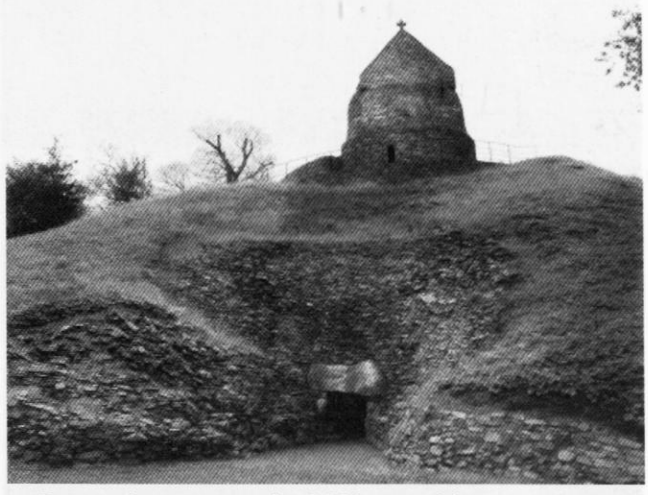
All the modern pipework material was stored outside. Near the tunnel entrance were Jersey Water's hard-to-get spare fittings. There were obsolete valves, pipe lengths and fittings for spigot and socket water mains. Nearby was a large number of decaying wooden boxes containing geotechnical core samples from construction of the later dams on Jersey in 1962 and 1991.

Inside the tunnels, some stalactites were over two metres long. An inscription read "Deutsche Asphalt 1944". At the escape hatch there were some remains of ventilation intakes and some old lamps. The 60cm rail track was in place in the side tunnels with the usual drainage channels and again there seemed to be no turntables at the junctions.

La Hougue Bie Neolithic passage grave

In complete contrast and as a change from German concrete, we moved on to La Hougue Bie in St Saviour, one of the island's twelve parishes located in the centre of the eastern part of Jersey.

La Hougue Bie is a Neolithic passage grave, constructed about 6,000 years ago, under a twelve-metre-high mound. The site has seen many uses over its long history. It is topped by a twelfth-century chapel now forming the crypt of a second chapel, added in the later mediaeval period. In 1792 these remains were converted into a folly residence, the Prince's Tower, by Philippe d'Auvergne. That was demolished in 1924 and the chapels somewhat repaired. There were now proposals to correct these restoration works as they do not meet Jersey Heritage standards.

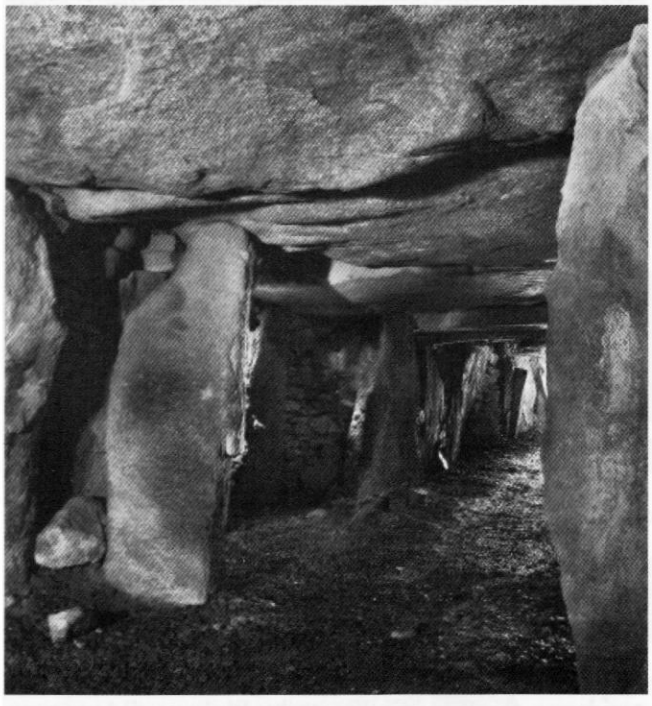


Restored entrance to the 6,000 year-old passage grave at La Hougue Bie, with mediaeval chapels atop the 12-metre mound. Photo Clive Penfold

Meeting Nigel Bartlett at the foot of the mound, we were introduced to the 4000–3250BC dolmen. This is one of three Neolithic passage graves on Jersey, but considered to be one of the finest in Europe. Restored between 1991 and 1995, the dry-stone facing around the entrance stabilises the mound. The tunnel was deliberately low, covered with seventy very large granite slabs weighing up to 22 tonnes; it is thus assumed that Neolithic people were good with ramps, leverage and rollers. Like at other sites, these stones are known to have travelled a considerable distance from the eastern part of Jersey, and they were drawn uphill.

Deep inside the 18.6-metre-deep passage are three side chambers and at the end a raised, centrally-located chamber containing miniature standing stones. The plan shape of the passage grave seems to reflect a recumbent human body (according to our guide). Unfortunately a Victorian column from a fish market has had to be added to stabilize the ceiling.

Neolithic people were probably scraping out a meagre existence. The timing for planting seed from the winter store would have been critical. The spring and autumn equinoxes roughly marked the beginning and end of the larder months and by careful practical observation they noted the exact times. The La Hougue Bie passage has exact solar alignment. We were told that even if it was not cloud-free, the event horizon here is spectacular. The sun penetrates the passage and hits the lower part of the target stone at the end of the tunnel, which glows with brassy, gold and orange colours – lighting up the void and the end chamber.



Entrance passage to the Neolithic grave, aligned with sunrise at the spring and autumn equinoxes. Some of the granite slabs weigh over 20 tonnes, Photo Adrian Armishaw

Nigel gave us a lengthy explanation of the significance of the orientation of the tunnel and the mound covering it, built up over many years. This dolmen conforms to a typical Neolithic pattern and at that time Jersey is thought to have perhaps supported three thousand people, with a life expectancy of maybe 25 years.

With so little evidence but so much human effort invested in them over such a long period, our guide explored the huge cultural significance of the dolmens. Excavations in 1925 did find human remains and grave goods nearby and it is believed the site was pillaged and that for some reason, La Hougue Bie was abandoned earlier than other dolmen sites. The nearby museum held a remarkably wide range of geological and Neolithic artifacts.

German fortifications at La Hougue Bie

The Germans recognized the strategic advantage of the high point the Neolithic people had built up over perhaps hundreds of years. They built an observation tower, an air-raid shelter and an underground command post, now a museum. So we didn't escape the concrete after all. Inside the bunker, the German telephone equipment, hand-powered ventilation units, stoves and fittings were by now familiar. The two stairways and simple corridor served side rooms. These had been transformed into a small museum to honour the forced labour that was driven by the Organisation Todt to construct the Jersey defences between 1942 and 1945.

Underground Command Post at La Hougue Bie now a small museum dedicated to the forced labourers from across Europe who worked and died in Jersey. Photo Adrian Armishaw

Reportedly, a hundred workers died on the construction sites. As General Patton despaired, there was a concentration camp for every letter of the alphabet. Alderney had two concentration camps; in these small satellites over seven hundred of the six thousand mainly Jewish and Russian inmates are thought to have lost their lives. One witness suggested that, weakened through labour while starving, malnourished and suffering disease, they had a life expectancy of nine months; another that their bodies were dropped in the harbour. The Alderney camps were shut down in 1944. Through moving, very personal but respectful exhibits, this simple display set out the enormous suffering and the human cost of the strategically-misguided concrete that we saw over the weekend.

Verclut Point Casemate and the Turbot tunnel

Our busy day continued as we moved on north, up the east coast. We had reached our most northeasterly extent and here the weather turned blustery, but at least it was not raining. The less hardy resorted to tea and scones in the café behind the breakwater. The Germans built a type-680 casemate at Archirondel, across the bay south of Verclut Point, and to allow crossfire, they built this 10.5cm type-670 casemate which was served by a tunnel that they partly lined.

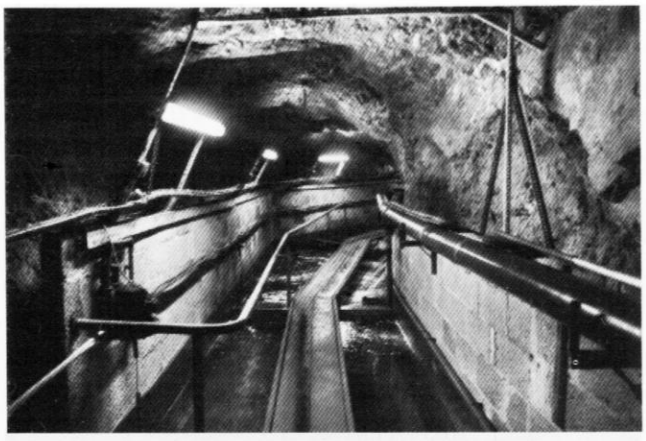
Entrance to the Turbot farm is, somewhat surreally, through the original embrasure of the type 670 10.5cm gun emplacement. Photo Adrian Armishaw

Turbot-charged tunnel

The tunnel is used by Jersey Turbot, a family fish-farming business. Back in 2000, his family were concerned about the risks of going deep-sea fishing, so they persuaded Dave Cowburn to test the fish farm idea using another bunker on Jersey. They then moved the turbot farm here, developing an existing vivarium in the tunnel behind the gun emplacement. Father and daughter showed us round in small groups.

Although the Cowburns take them as fry from France when they are about the size of a £2 coin, they know they will steadily increase in size if properly nurtured. The tunnel contains a series of concrete tanks, with pumps, aeration and filtration equipment. The turbot are transferred through the tanks as they grow and after four years they reach the size of a dinner plate. Ready for table, they are now extremely valuable. When fed on bonemeal and seaweed pellets from France, the fish rise vigorously from their subdued activity on the bottom.

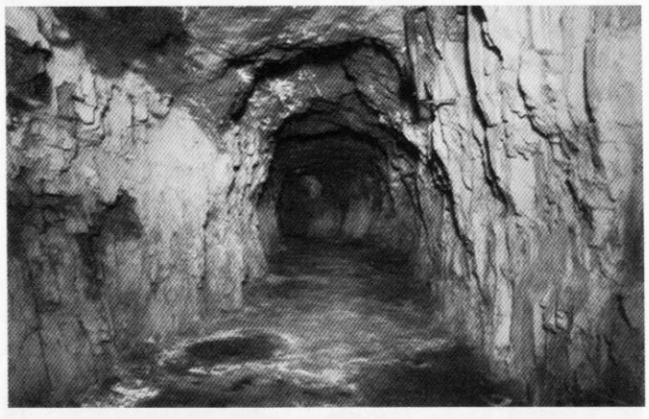
And so at the end of a packed day, the coach took us back to our hotel via the Royal Bay of Grouville, passing steep slopes growing Jersey Royal potatoes. Only the most observant will have spotted the shy but celebrated Jersey Greyback Sheep. John Germain pointed out the raft of modifications the Germans had made to the existing fortifications. Bunkers still turn up unexpectedly on the island; a *Sechsschartentürme* (six loop-hole turret) bunker was uncovered when modifying the course at the Royal Jersey Golf Club – perhaps the most unusual bunker on a golf course.



Part of the unlined tunnel of the turbot farm, with walkway above the 6,500 turbots in residence. Other parts of the network are brick-lined but the emplacement was never completed. Photo Dom Jackson

Sunday 6 May – starting with storage tunnels Ho1 and Ho2

We left the hotel in drizzly rain and pulled up to investigate storage tunnels Ho1 and Ho2, straddling the St Peter's Valley road a little north of St Aubin's Bay. We could only see into the round-arched entrance to Ho1, an extensive munitions store having two major tunnel spurs as well as a grid behind the looped entrances, unfinished and only partly lined. After the war it received anti-aircraft guns, but was cleared for scrap in 1948. Used as a mushroom farm until 2006, it is now a secure storage facility. An oil-tank, a large flue and a small cooling tower occupied a high compound at the upper entrance.



For much of its length Ho 1 is unlined

We found the upper entrance to Ho2 over the road. We could only see in through bars in the entrance grille as we had been refused permission to enter. The lower entrance was concrete-lined and the sealed doors had been sheeted. Ho2 was a rations store, having the typical looped service route leading to a grid of stores. Break-ins led to tragedy in 1962 when two boys were asphyxiated because of a fire inside the tunnel the previous day, hence it is now off-limits.

Photographs suggest that many areas were unfinished and that there was 60cm track inside. Parts of Ho2 were blown in by the British. More Flak guns and general equipment are thought to lie beyond those rockfalls, but

the damage from the explosions goes right to the surface and access is considered far too dangerous. Nearby next to the road was the overgrown reinforced concrete frame of the German stone-crushing plant.

The main tunnel at Ho2 in 2003.

Heavy machine-gun bunker at Val de la Mare

On a continuing grey morning, we passed along St Ouen's Bay on the west coast to the bunker overlooking an obvious beachhead. The Germans constructed fifty defensive positions along this beach, including Jäger casemates and a large anti-tank wall incorporating type-631 casemates. The Germans used the railway here – as well as a new branch line to the quarries at Ronez, they added track inland here at Val de la Mare and an isolated railway along this coast to bring construction material from the quarries near L'Etacq.

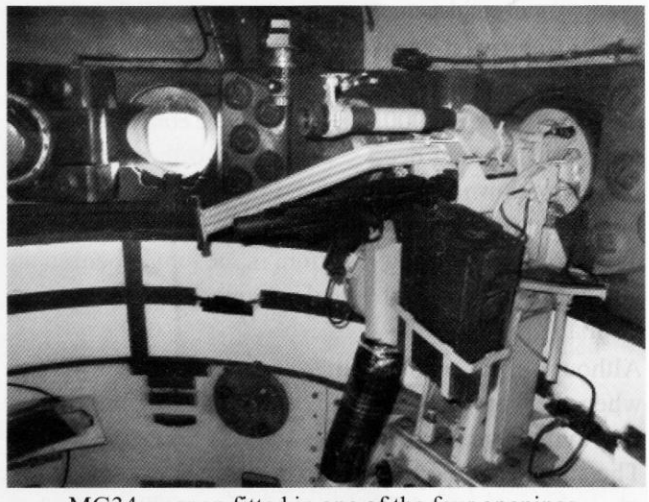
Where we stood, nearly 700 metres behind the beach, the Germans demolished the old watermill and built a well-hidden resistance nest at Val de la Mare. An incline led us to a complex of air-raid shelters, ammunition stores, open gun platforms, trenches and mortar positions; but most importantly, a sophisticated MG turret on a type-632 bunker. This *Sechsschartentürme* was well camouflaged with stonework leaving just the ball mounts and periscope opening on view.

Stewart Wild admires the view from the Val de la Mare machine gun post. Photo Martin Dixon

Seven other S*echsschartentürme* turrets on Jersey were scrapped; the only other survivor is on a much smaller bunker at Wn Doktorhaus, inland on the Mont Mathieu road. There were many versions of these – the cupola armour thickness could be 20, 25, 30 or 45 cm with one, three or six loopholes; there could be one or two MG carriages and there were adaptations for different weapons.

Restoration

This bunker, 4-s WaKoFest Wn La Mare Mill, is being restored by the Channel Islands Occupation Society (CIOS). We climbed the ladder to the platform carrying the MG34 mounting via one of the two trapdoors. John Germain and team had installed a replacement MG34 on the carriage (Lafette), which moved easily on its guide rail. By exchanging hinged armoured plugs in the turret, the weapon could be smoothly engaged with a different port.



MG34 weapon fitted in one of the four openings. The ammunition box and chute for spent cartridges can easily be seen. Photo Clive Penfold

The ease and precision were impressive. The four active openings gave a wide field of fire. Underneath, tubular ductwork brought fresh air to each port from modular hand-wound fans and gas filter units. Two ducts could collect spent cartridges. The *Pz.Beob. Winkelfernrohren* – an optic for armoured vehicles – moved with the carriage, giving a bright and sharp image of the potential killing ground on the distant beach and a 120-degree field of view.

The bunker had a further MG position in a stepped embrasure. This guarded a sheer-sided cutting three metres deep that led to the entrance. Beside it was a comma-shaped shaft with a step halfway up, so that troops could rapidly retrench. Bizarrely, the air-raid

shelter on the outcrop contained cymbals and a drum kit, presumably banished from a neighbouring house.

Les Landes and the West Batterie Moltke

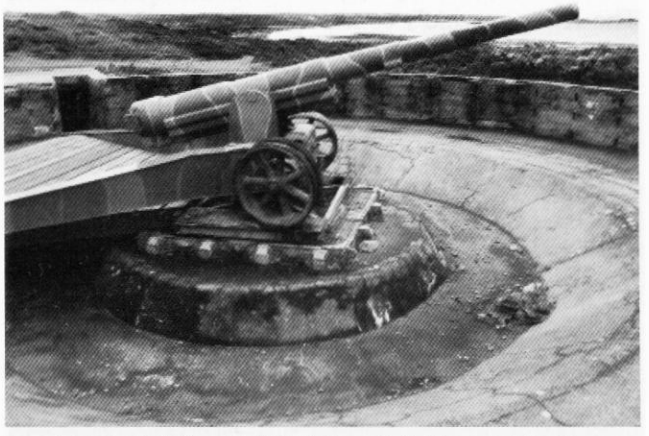
Next, we moved on to the most northwesterly extent of our visit. Constructed in the spring of 1941, the Moltke complex had four 15.5cm K418(f) coastal gun emplacements overseeing shipping in the Channel. They were served by an M151 ("M" denoting a *KriegsMarine* version) crew bunker and type-512 ammunition bunker linked by underground passageways, with two observation posts, M2 and M2a. The guns were outdated but a scheme to add a 15cm SK C/28 was abandoned. In 1946 these guns went over this cliff and about a dozen were visible at low tide. One on its locally adapted carriage has been reinstated by CIOS.

Standby room for the crew at the Moltke coastal battery. Photo Dom Jackson

On a brightening afternoon, I reached the stunning fire control tower MP3 (*Marine Peilstand*), overlooking Rouge Nez cliffs. Classified MP3 *Stp Butts*, this was the last direction and range-finding tower to be built on Jersey, but nine were originally planned and there are similar towers on Guernsey. Unlike MP1 and MP2, the tower had a slightly conical shape. MP3 had a square rotating antenna on the roof and ground-mounted radar.

The tower housed *Fu Mo* (*Funkmess Ortungsgeräte*, literally 'radar set') West and had an eastern counterpart (*Fu Mo Ost*) located at Stp Victoria Tower, near Mont Mallet, but these only provided early warning and could not direct fire from the coastal batteries with any accuracy. Although German records suggest that the tower was fitted with Freya early warning radar, the consensus is that it was a *Kriegsmarine Gema Fu.M.O. 2* (*Seetakt*). The combined generator and personnel bunker and two Fl 242 anti-aircraft bunkers lay behind MP3. In 1946 the guns were dumped over the steep cliffs by the Royal Engineers.

Heading back to Batterie Moltke, entry to one of the large circular gun emplacements was possible through a side hatch, down rungs and over concrete pourings from an attempt to seal it. Just inside was part of a rusting ammunition hoist. The surprisingly extensive compartments led to a forward MG position and escape shaft, the remains of ductwork with an air heater coil and some service trenches. The blast doors had all been unhinged for scrap and there had been a fire inside.

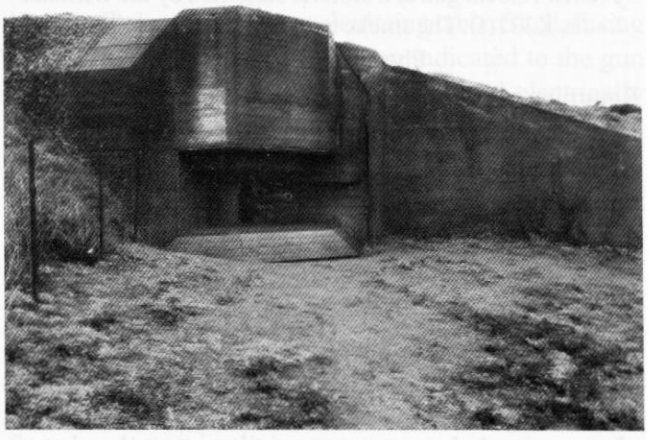


Original 15.5cm K418 (f) French field gun at Moltke German Army battery, Les Landes. The barrels were tipped over the nearby cliffs by the British army in 1946 and this example was recovered by the CIOS in the 1990s. Photo Adrian Armishaw

More German concrete at Corbière Point

We arrived at the southwest corner of Jersey, at La Corbière. Prominent on the cliff top was the cylindrical MP2 radio tower, with five levels of ranging apertures looking seaward over the lighthouse and the rocky shoreline. The glazed observation turret now seems to be a modern penthouse, making the coastguard station a private retreat.

We were also there to see a casemate below MP2. There are thirteen of these Jäger casemates on Jersey, locally designed by a German engineer with that name. This is the only one to keep its original weapon (another from St Brelade's Bay was transferred to Guernsey some years ago), a relegated 1918 French 10.5cm gun, which the Germans classified as K331(f). The steep slope probably ensured its preservation. On the roof, there was evidence of railings around the standard retrenchment shaft and an MG embrasure protecting the entrance to landward.

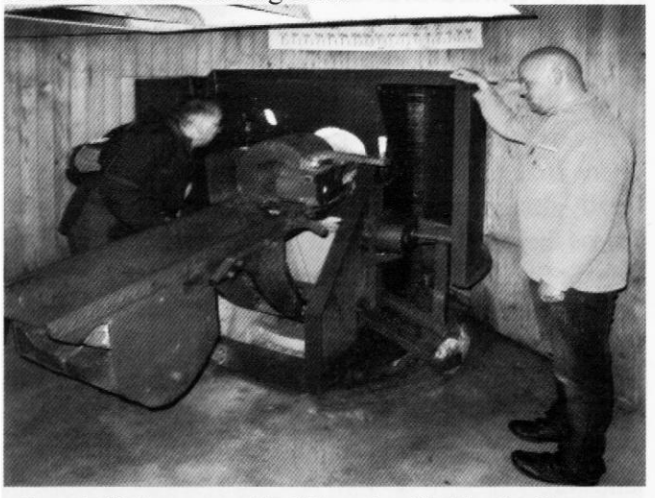


Jäger casemate at Corbière complete with original weapon – a reused 1918 French 10.5cm gun. Photo Adrian Armishaw

The Germans developed several generations of standard designs for their defensive positions, often locally adapted. Most of the Atlantic Wall was built to B standard, with up to two-metre-thick concrete. This was considered able to resist artillery up to 210mm and 500kg bombs. The Kriegsmarine's concrete emplacements restricted traverse and assumed they would only be attacked from the sea; whereas the army preferred carriages and open emplacements.

Inside, the bunker had been painstakingly relined and repainted, CIOS leaving the inscriptions and collecting a wide variety of loose equipment to recreate the wartime environment. CIOS had even lit the original stove to make the inside warm and toasty on this blustery and chilly afternoon.

The equipment includes deactivated mines and flamethrower pots for beach defence, petrol and diesel portable generators, bunks and telephone sets. The electrical and telephone intakes, alarm bells and handsets were complete and so was a centrifugal extract fan serving the casemate and a gas-tight generator room – complete with underfloor air intake. The usual HES2.4 hand-powered fan and gas filter combinations served the gas-tight areas. Smaller bunkers like this had wood stoves for heating, whereas the largest ones had coal-fired boilers adapted with overhead steam drums to serve radiators and air heating coils.

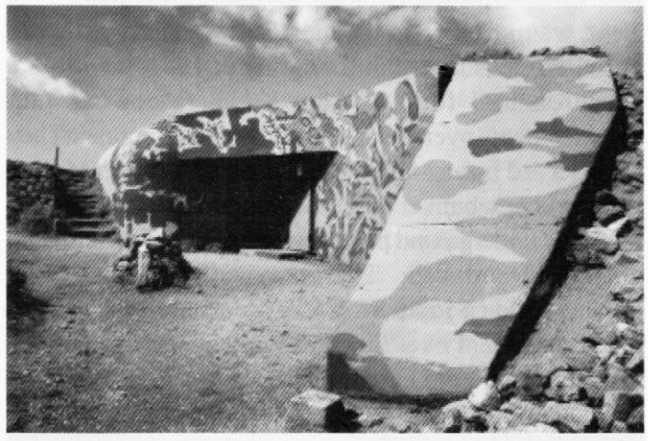


French 10.5cm gun at Corbière, classified by the Germans as K331(f). The smoke extract hood is just visible.
Photo Clive Penfold

Returning in 2006 and impressed by the CIOS restoration, Herr Engelbert Hoppe, the M19 and Stützpunkt Corbière Commander in 1944–45, said: "I had expected only ruins… it's as if I had only left the bunker yesterday."

Machine Gun Bunkers 633 and 634

The brief walk on the shoreline brought us onto the La Corbière promontory with its lighthouse, overlooked by an M1 observation bunker. The roadway led to a 606 double searchlight emplacement and underneath was another Jäger casemate, now sealed. But our interest was classified as Bunker 633 M19 Stp Corbière, unique on Jersey because it serves an M19 *Maschinengranatwerfer*. Furthermore an underground passageway connects it to type-634 bunker which used to carry a *Sechsschartentürme* MG turret.



Type 633 automated mortar bunker at strongpoint La Corbière. Restored camouflage to original design.
Photo by Tom Brossman

The M19 bunker was built in less than four months between 1942 and 1943. This highly automated mortar could fire 120 bombs a minute in a lethal hemispherical field over the beachhead – even onto its own roof – from a small port in its thickly armoured turret. In 1945, this high-performance weapon was quickly recovered by the British. The heavy, bell-shaped turret and all the metalwork were taken by the scrap merchants in 1953 and the bunker gradually became buried.

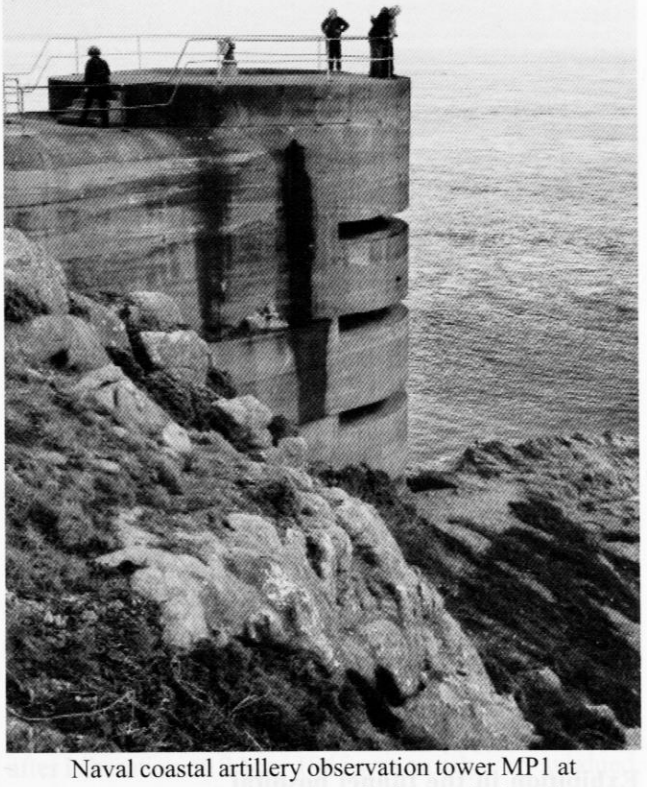
The mortar was aimed by periscope and fired from an upper platform inside the turret which CIOS have replicated. Sets of mortar bombs were brought from the magazine to the ammunition lift on the lower level. The fumes in action can be imagined from the larger hand-wound ventilation fan and gas filter. CIOS hope to complete a full replica of the mortar. Stairs down to a round-arched tunnel, about twenty metres long, led to a staircase up into Bunker 634 and the structure of that bunker appeared to have broken. Permanently lit, the restoration includes all kinds of recovered contemporary equipment.

Underground steps and passageway linking the unique M19 automated mortar bunker at Corbières with the adjacent (type 634) heavy machine-gun post.
Photo Dom Jackson

The sun had come out and we were free to roam around the rest of the headland. Some of us enjoyed luscious Jersey ice creams; although one Sub Brit member lost his to a marauding seagull – they seemed to have learned how to acquire a tasty snack! Brian mistook two loitering tourists for Sub Brit members and gave them the shock of their lives when he ordered them back onto the waiting Sub Brit bus!

Batterie Lothringen at Noirmont Point

Our final stop of the afternoon was on a southern promontory of St Aubin's Bay, overlooking a Martello Tower. Batterie Lothringen at Noirmont was one of five coastal batteries installed during the Occupation. CIOS have opened the cylindrical MP1 fire control tower, which has four levels of ranging apertures, with a fully enclosed floor below them.



Naval coastal artillery observation tower MP1 at Noirmont Point. The remains of a 2cm anti-aircraft gun can still be seen on the roof. Photo Dom Jackson

Unlike the high-profile MP2 and MP3 towers, this tower was built below the top of the cliff. New handrails surround the roof mounting for the 2cm Oerlikon anti-aircraft gun. Parallels between those slitted facades and postwar buildings, like Wright's 1956 Guggenheim Museum in New York, have raised suggestions that the MP towers represent the architectural transition from prewar to postwar style, largely dictated by the industrial construction methods.

Anyway, the first three Krupp 15cm SK L/45 naval guns dating from 1917 were completed in 1941 – a fourth gun was added later. These guns were on open platforms with simple armoured hoods. They were loaded from ready-to-use storage, supplied via access ramps and pathways from the central ammunition bunkers. In 1996, the No.1 gun was recovered from the shoreline and is now back in position.

Your Chairman surveys the original 7-inch-thick armoured cupolas and the restored range-finder of the command post for the Lothringen naval coastal battery (M 132) . Photo Dom Jackson

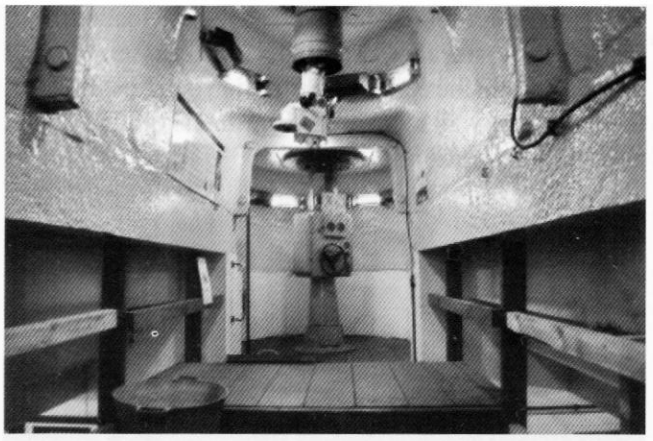
Command Post M132 at Noirmont

CIOS also run the type M132 command bunker, topped by an impressive armoured-steel cupola carrying two periscopes plus a separate range-finder turret. Construction started in March 1943 by blasting a large L-shaped opening in the cliff. The entrance, down a ramp, leads onto the upper floor with its operations room, basic welfare facilities, plotting areas, radio room and telephone exchange. This room and its twelve-man crew would have operated just like the fire control centre on a warship. To reduce noise during calculations, the room was carpeted.

As usual, there was an escape shaft and a ladder reached a gantry above for the cupola range finder and periscopes. The forward directional aiming periscope was for night-time use with illuminating starshell, the rearward one for daylight. Both of these had 10x magnification and established the direction of the target. Distance was determined with the stereoscopic range finder. This and other data, such as wind speed, were processed electrically by the ballistic calculating table. Shell, fusing and aiming instructions were then indicated to the gun crews. Eventually the guns could be fired electrically from a tripod inside the bunker.

Batterie Lothringen saw action 55 times between 1941 and 1945. Once opened to the public in 1948, anything that could burn was rapidly stripped, equipment was smashed and then a few years later it was scrapped.

As part of the restoration by CIOS, a new range-finder turret has been made but the range-finder arms were brought back up from the shoreline. CIOS have fitted a replacement periscope from a British tank. The lower floor level contains living quarters and plant rooms for the coal-fired heating and ventilation, including the usual



Interior of the Lothringen naval coastal battery command post (type M 132) cupolas, showing ex-tank periscope installed by the Channel Islands Occupation Society. Photo by Tom Brossman

gas filter units and over-pressure valves, with a good selection of exhibits.

Outside the command bunker were a variety of trenches, passageways, searchlight and FlaK platforms and smaller shelters which have gradually been uncovered. Behind the command centre is the v101 personnel bunker which has some wall paintings inside and a large ammunition bunker. Both of these are flush with the surface and reached by protected ramps.

Our evening's entertainment

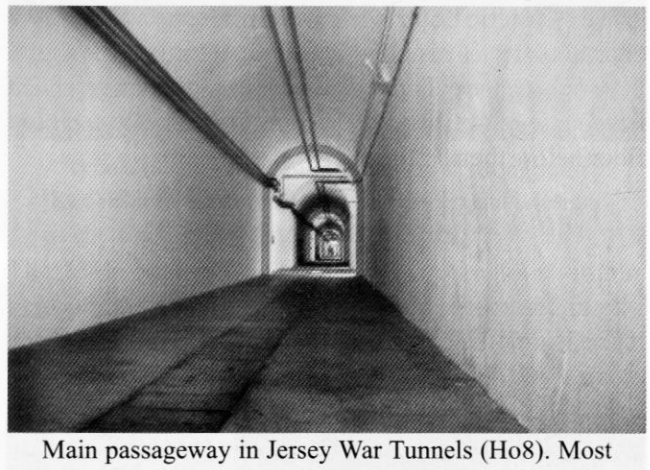
We returned for our Conference Dinner at the Merton Hotel via tunnel Ho19 by the harbour, now containing a substation. We also passed the Allied war cemetery near the hotel, established in 1943. It mainly held the dead from HMS *Charybdis*, a destroyer sunk that year, but also some US Navy personnel whose remains have now been returned to America.

At dinner, only John Burgess remembered the rule about wearing a tie. Our table naturally insisted on drinking Paddock, a nice chardonnay from Australia. We gathered in the basement of the Merton for our conference presentation. Our talk was given by Dave Maindonald, a long-standing member of CIOS, who delivered a captivating presentation outlining his research into the fortifications of the Occupation. Responding to increasing concern by the authorities to preserve them, he is now preparing a complete resurvey.

Monday – the Jersey War Tunnels (Ho8)

Our last site of the study tour was a public museum, originally opened as the Underground Hospital and now known as the Jersey War Tunnels. Located in St Lawrence, just north of St Aubin's Bay, Ho8 was originally planned as a large network of tunnels for an ammunition store and underground barracks. Opened out by blasting and by slave labour combined with well-paid volunteers, all using hand tools, Ho8 is 33 metres below the surface. Tunnelling extends for more than 1,000 metres – one corridor is just over 100 metres long.

By 1943, preparations for some kind of European invasion were clear and Ho8 was converted to a casualty clearing station with a 500-bed emergency hospital and an operating theatre. It would have only served the German military although their medical officers preferred to use the island's existing hospitals. Steam heating and mechanical ventilation were added. Functional pipework remains and the old plant is original or has been well-replicated. In 1946, the States of Jersey opened the tunnels to the public, but in 1961 it was ruled that the tunnels actually belonged to the landowner above.



Main passageway in Jersey War Tunnels (Ho8). Most tunnels in Jersey followed a curving course which aids vehicular access whereas Ho8 has a grid layout. Photo Dom Jackson

Although the tunnels were emptied after Liberation, the more technical hospital facilities have been partly reproduced by the museum, combining them with a wide range of artifacts, archive and modern media explaining what life was like on Jersey during the Occupation. By the time Ho8 was converted, the round-arched tunnels were incomplete and unfinished areas were simply bricked up.

Simulation in one unfinished area illustrated how the tunnels were blasted and the loosened material brought down by manual labour using long poles. The story is that a rockfall entombed nine labourers in Ho8 which, despite its lighting and hospital appearance, felt the most uncomfortable of the tunnels I visited.

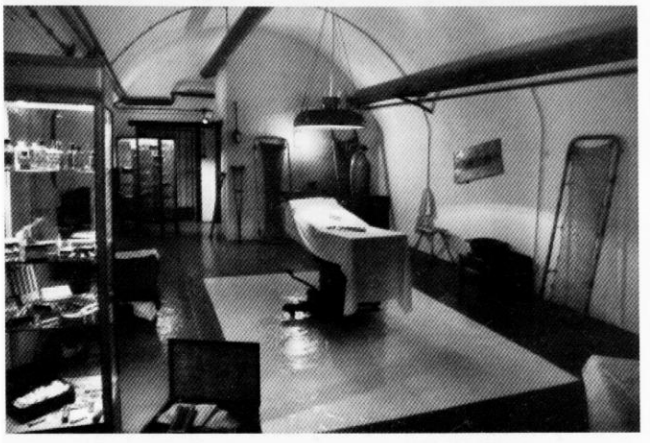
Exhibition in the tunnel hospital

This was very thorough, very moving. Although the most combative residents had already left Jersey, about five percent of the population ran into trouble with the occupying authorities. This 1941 entry to Mary Deslandes' Occupation Diary reads:

> *"...The army of Occupation seems to have settled down to a steady 8,000 now and we have grown quite accustomed to having them around. No one hates the poor wretches individually. They provoke no one and a better behaved, more inoffensive body of men it would be impossible to find. What one does hate, with a bitter, corrosive hatred, is the*

system they represent and the conditions which their presence here imposes. They are very much the dominant autocrats in possession and only by favour of their much vaunted magnanimity are the natives allowed to live on their own island, on sufferance, shorn of their rights and almost of their liberty."

On the new North Quay in St Helier there is a memorial to twenty exceptional residents who had defied the Germans during the Occupation. All of them died as a result of maltreatment in prisons and concentration camps in occupied Europe.



Reconstructed operating theatre in the Jersey War Tunnels (Ho8). Photo Dom Jackson

Many of the stories were very moving: Louisa Mary Gould hid a wireless set and sheltered an escaped Soviet prisoner. Betrayed in 1943, she was arrested, sentenced and transported in August 1944 to Ravensbrück, perishing in the gas chambers in February 1945. Posthumously awarded the honour of British Hero of the Holocaust in 2010, she has a memorial in St Ouen.

Another twenty Jersey people were awarded gold watches in 1966 by the Soviet Union for assisting escapees. For the non-collaborating residents, the Occupation diet had been extremely poor with all kinds of substitutes – even returning to reasonable food brought problems. However, the islanders' attitude to Germans after Liberation on 9 May 1945 was mostly very subdued.

The Study Tour concludes

As we boarded the coach for the final time we all agreed that this had been a fantastic weekend – with a great introduction to the German fortifications; clearly there are many more to see. It was now the official end of the weekend.

Jenny and I said our goodbyes and stepped off the bus to view St Matthew's Church, remarkable for its moulded white glass (*verre blanc moulé-pressé*) interior. It was designed by René Lalique, complemented by oak pews by AB Grayson and all enhanced by electric lighting. However, we found the building closed, so could only

Reconstructed track and tipping wagon in the uncompleted section of the Jersey War Tunnels (Ho8) .
Photo Adrian Armishaw

imagine the art deco lighting, architectural glass and uplifting simplicity of the space inside.

Walking back along the beach to St Helier, we passed type-631b emplacements that housed 4.7cm PAK 36 (t) guns in the sea wall around Millbrook. Finally the sun broke through as we visited the Boat Show in St Helier harbour, browsing luxury yachts and accoutrements.

We did however get aboard the fisheries protection vessel HMS *Mersey* and toured the bridge. The officer explained the sophisticated yet intuitive sail-by-wire controls. Suddenly there were sirens everywhere and the crew looked distraught – from the captain's seat a four-year-old had lifted the button flap and pressed Abandon Ship! Luckily not a Sub Brit member but perhaps one in the making.

Altogether it was a great weekend with a large and diverse group managed with the usual Sub Brit precision, this time by Hillman Tours: thanks Brian. Also huge thanks to all the individuals and groups who gave their time to allow access and guide us round such a large number of most interesting sites.

References

Subterranea Britannica Jersey Study Tour 2012: Site notes prepared by Brian Hillman and others.

Various publications by the Channel Islands Occupation Society.

The Ultimate Sacrifice, Jersey and Occupation:
www.jerseyheritage.org/media/PDFs/sacrifice.pdf

WMF News: The Atlantic Wall in Jersey.

Jersey Railways: www.jeron.je/thatwasjersey/rail.html

St Catherine's Breakwater:
www.theislandwiki.org/?title=St_Catherine's_Breakwater

Axis History Forum, various contributions: deployment of ground radar in the Channel Islands.

Atlantic Wall as Architecture:
www.lablog.org.uk/wp-content/papercadiz-awbunker.pdf

Axis History Factbook, Bunkers in Jersey:
www.axishistory.com/index.php?id=6715

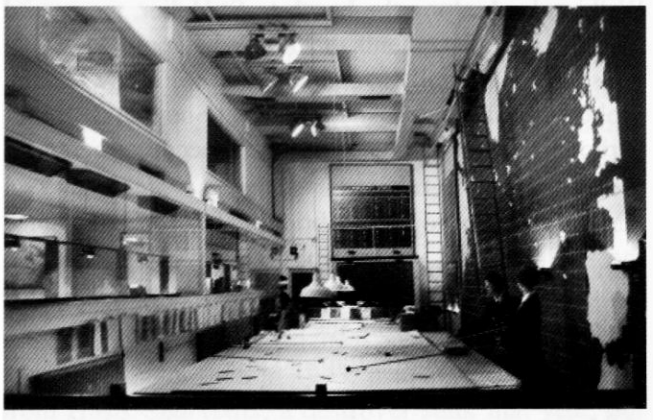
Underground Liverpool in World War Two

Chris Rayner

Sub Brit's Autumn Meeting this year is being held in Liverpool on Saturday 13 October, with visits to some of Liverpool's many interesting sites on the following day, Sunday 14 October. The Merseyside area is particularly blessed with interesting underground sites of various types, such as abandoned and live rail and road tunnels, philanthropic follies, mines, and wartime bunkers and air-raid shelters, some of which we are hoping to be able to visit.

There is a very good range of survivals of underground shelters from the wartime period which are illustrative of the difficulties faced by Government and Local Authority planners in the period from 1936 to 1941. For although the Merseyside area would have been at the limits of the range of German bombers, it was clear that the city's strategic importance would make it one of the prime targets in the country.

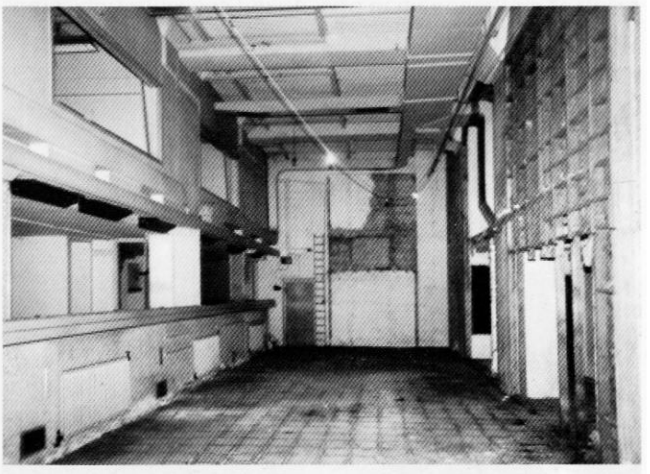
Derby House



This is an image of the Area Combined HQ of the Royal Naval "C in C, Western Approaches" and the R A F "AOC, 15 Group, Coastal Command". On the far left wall, the office window of the AOC 15 Group with below, that of the RAF Controller. Nearest on that wall is the office of the C in C, Western Approaches with below, that of the RN Duty Commander. The wall plots at the far end and right side are of the RAF. The door leads to a large joint communications facility. The large wall plot nearest the camera is the main naval plot, other subsidiary plots and charts are behind the camera. Unfortunately, this restoration has introduced a very large, horizontal plotting table, complete with pendant lighting, which never featured in this ops room, neither did the map up-lighters on the main naval plot or the banks of telephones. The manikin at the far end wears a post WWII hat whilst the other two, of WRNS officers, would not have undertaken this plotting task had this table been a feature of this HQ. The space occupied by this huge table was in fact used for a series of six or seven large and small desks filled with the many files and documents needed to update the plots and maintain a record of past events.

The most important surviving wartime structure in Liverpool is in the basement of Derby House, in the city centre. Here were the Combined Operations or Western Approaches Headquarters from which the Battle of the Atlantic, or at least the Allied part in it, was planned and controlled. The reconstructed bunker is now open to the public as the Liverpool War Museum.

The Headquarters was relocated from Plymouth in 1941 at Churchill's instructions, and it seems a logical location given Liverpool's status as the main wartime convoy port of Britain (over a thousand convoys arrived here during the war). Hitler apparently suspected that the control bunker was in Liverpool and the heavy bombardment that the city received is in part credited to attempts to destroy it.



The operations room at Derby House in the 1980s, before restoration started. Photo from Sub Brit Collection

From this building the Royal Navy and the RAF worked together to monitor Allied convoys and "wolf packs" of U-boats in the Western Approaches, the eastern half of the Atlantic Ocean to the west of Britain. The nerve centre was the Operations or Map Room at lower basement level where there were up to fifty Wrens on duty 24 hours a day updating position indicators and display boards.

The centrepiece was the large Situation Map showing known or suspected enemy positions, and locations of Allied convoys, escort groups and air patrols. An Aircraft State board indicated the readiness of RAF stations to send air support, and recorded ongoing air operations. Overlooking this at mezzanine level was the glass-fronted office of the Commander-in-Chief, from which he gave instructions via a speaking tube.

Telephone 'hotline'

Churchill apparently visited regularly. A 'hotline' telephone linked to the War Cabinet survives and may have been used by him – it was overseen at all times by an armed guard and is one of only two such phones which survive.

Other rooms on view include a cinema, a projector room, switchboard/signal and phone exchange, and a heavily guarded codes and ciphers room housing an Enigma machine. There was also a sun-ray treatment room to help compensate for the long hours (at least fifty hours a week) that staff would spend underground.

The hundred or so basement rooms covering around 5,000m^2 were called the Citadel or Fortress by staff.

Extensive reinforced-concrete protection was provided including a 2.1m thick roof at ground floor level

The Cunard Building

Employers in high risk areas were encouraged to put forward schemes for the protection of the workforce from 1937 onwards. The take-up was slow even when tax incentives and, in the case of new shelters, grants were subsequently offered. It was not until the 1939 Civil Defence Act that a legal duty was placed on employers to provide air-raid protection for their staff.

Solidly built buildings in inner city areas were in many cases considered strong enough to withstand bomb damage with just minimal strengthening. The Cunard Building, the middle one of Liverpool's *Three Graces* – a prominent group of buildings on the Mersey waterfront – was one of these. It was built during the First World War as the headquarters of Cunard, the premier transatlantic shipping line, and in its day it operated in a similar way to a modern-day airport, checking in passengers and luggage

Cunard's importance continued during World War II, its liners having been requisitioned as troopships. The two Queens (*Queen Elizabeth* and *Queen Mary*) were credited by Churchill as having shortened the length of the war by a year due to their large troop-carrying capacity.

Air-Raid Survival

The lower basement of the Cunard building was requisitioned for use as the central ARP Headquarters of Liverpool during the war while at the same time being an air-raid shelter for the building's employees and for those of some surrounding buildings. ARP (Air Raid Precautions) was the organisation tasked by the Government with the protection of civilians during the war, covering aspects including the issuing of gas masks, maintaining the blackout, running air-raid shelters, and rescuing and helping survivors after air raids.

This original reinforced-concrete structure was supplemented with a steel frame in preparation for the war. Original painted signage from this period records which parts of the basement were used for which functions – "Control HQ", "First Aid", and the twelve air-raid shelter bay divisions are painted onto the original concrete beams. The likelihood is that these signs record wartime subdivisions of the basement by blast walls which would have been removed after the war.

The first aid area beneath the Cunard building

The Royal Insurance Building

Basement and cellar strengthening by steel and timber strutting formed a large strand of the Government's Air Raid Precautions policy. Other city-centre buildings are known to have similar basement shelters.

The Royal Insurance building in North John Street, for example, is another high-quality early twentieth-century building with two levels of basements. As at the Cunard Building, only the lowest basement level seems to have been used, and there is no surviving evidence of secondary strengthening except for the apparent installation of subdividing blast walls. As it was one of the earliest steel-framed buildings in this country the owners probably felt it was strong enough, and seem to have been more concerned with alternative escape routes.

One problem with having shelters in basements is that, even if the basement is strong enough to withstand the building collapsing on it, escape routes are likely to be blocked by debris. In this case secondary escape routes were provided as an afterthought by cutting diamond-shaped holes between the new basement rooms. The diamond shape seems paradoxical, as a rectangular opening with a lintel would be stronger in compression, but the shape appears to have been chosen to deal better with the complex multi-directional forces generated by bomb blasts.

In addition, vertical escape routes were provided via pre-existing building perimeter vents (these have also been described as coal chutes or service ducts and their original function is unclear) handily signed either as "Escape" or "No Exit", presumably to retain one in each chamber for the original purpose.

Littlewoods

Where there was space on a building site, an external shelter was likely to be the favoured solution. This reduced the likelihood of the air-raid shelter being crushed by the building above collapsing or of the escape route being blocked by post-impact debris. Many of these began as simple trenches dug in haste at the time of the Munich crisis of 1938, which later were lined and roofed with concrete, and then covered with earth to reduce the effects of lateral blast.

At the Littlewoods site in Edge Hill, the shelter was parallel to the building to allow rapid filling via several gateways. The Littlewoods building was used in the war for various activities in support of the war effort, including printing National Registration forms (on the outbreak of war seventeen million were printed here over three days), assembling the floors of Halifax bombers, and by the code breakers of MC5, the government office that intercepted mail to and from suspected enemy agents.

As it was built in 1938, the air-raid shelter is a relatively early one, though the construction (a half-buried precast concrete modular run of tunnels 350m long) is similar to scores of later shelters.

Surviving wall art in the Littlewoods shelter.
Photo James Melcher

Its great treasure though is the remarkable series of portraits of men and women at the south end. Several wear helmets and the picture quality suggests that they may have been painted from life, perhaps to entertain the occupants during the tedious wait for the All Clear. There are men and women, and one portrait even cleverly appears to work around a pre-existing stain on the concrete surface.

Civilian Air-raid Shelters

There was a prevailing mood in the Government at the time against deep shelters being built for the protection of large numbers of civilians. Their effectiveness from high explosive bombs was questioned, based on reports of their performance in the Spanish Civil War, and there were also concerns about costs.

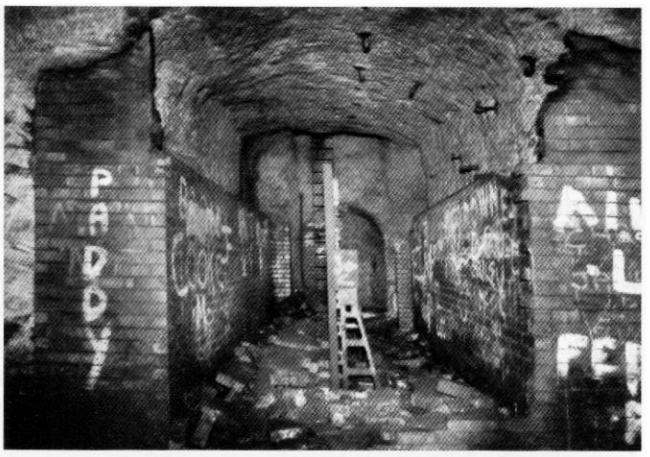
The Government's preference for almost two decades had been for smaller, dispersed shelters, and so the large deep shelters that went ahead all had very specific causes, such as their being in areas with previously excavated mines and tunnels, or eminently suitable geological conditions, or even very determined local authorities who were willing to risk losing government grants to build the shelters they wanted.

Bidston

The two large civilian shelters under the sandstone hills of Bidston and Tranmere in the Wirral, across the Mersey from Liverpool, were among the few exceptions to the rule and were generously grant-aided by the Government. Apart from geology, another possible reason cited was the need to protect the skilled dock workers.

Bidston's shelter was in the side of the hill allowing access at grade into two main entrances, while at the uphill end a 25m ventilation shaft was sunk, doubling up as an emergency escape via a series of steep metal ladders. The tunnels in between these ends were dug out in a familiar gridiron layout, with four long tunnels fed at both ends from the two main entrances, and eleven cross tunnels.

Toilets, a canteen, and a first-aid post were provided either in the cross tunnels or at tunnel intersection nodes. Within the shelter 1,596 bunks and 793 seats were provided for those lucky enough to have the requisite permit.

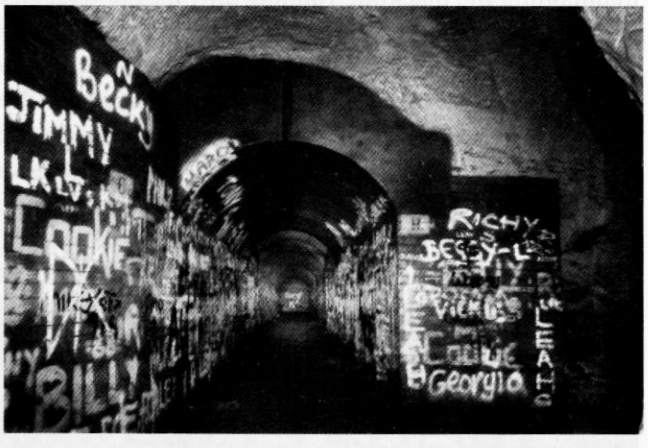


A ventilation shaft in the Bidston shelter which also doubled as an emergency exit

Construction began in December 1941 and was largely completed within a year, despite having suffered from escalating costs, geological problems, an unskilled labour force, and also – paradoxically – trespassers and vandalism!

The original intention was that the tunnels would be 2.1m wide and 2.0m high with an arched roof, but the surviving tunnels are considerably larger than this. Almost certainly this was a design change from early on although the considerable height was also partly a result of roof trimming required in the latter stages of the project due to the softness of the rock and problems with instability after exposure to the air.

The shelter, like many of the deep shelters reluctantly approved by the Government, came too late to provide mass protection during the periods of heaviest bombing. After the war it was used for Customs and Excise storage, fire brigade training, and was even considered for Cold War use but rejected due to extensive dry rot.



One of the main shelter tunnels at Bidston.

The Borough Council visited in the 1950s to see if they could find a use for it, but disapprovingly recorded it to be "damp, dark and featureless". Local groups in the last decade have looked at ways of reopening the shelter as a tourist attraction, and hopefully one day will be successful.

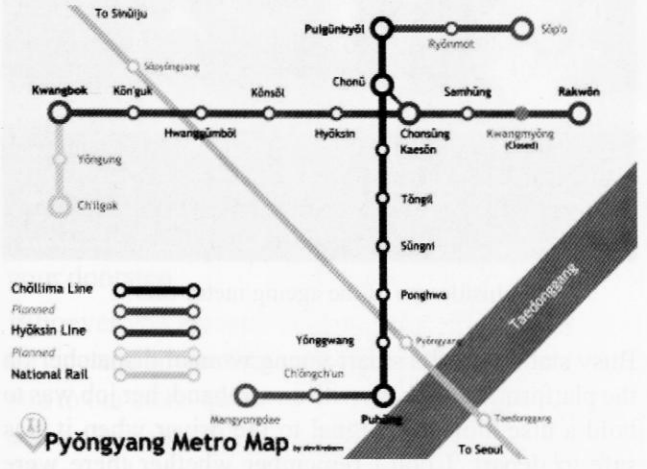
All photos by Chris Rayner unless stated.

A Ride on the Pyongyang Metro, DPRK – the World's Deepest

Stewart Wild
with On-the-spot Guidance from David Ferris and John Smiles

North Korea is one of the world's more difficult countries to visit, although several Sub Brit members have made it in recent years. We enjoyed a visit in April 2012, to coincide with the centenary celebrations of Great Leader and Eternal President Kim Il Sung. Nearly all visitors enter the country by air from Beijing, and return to the Chinese capital by overnight train, as we did.

Reliable information about anything underground in DPRK, or anything else for that matter, is notoriously difficult to obtain, and reports of secret underground railways, bunkers and vast tunnel complexes throughout the country may be true, not true or greatly exaggerated.



Of one thing however, there is no doubt: the capital Pyongyang has a Metro system, apparently with seventeen stations and a combined line length of around 22 km. All the track and stations are deep underground and the system is believed to be the deepest in the world, deeper even than Moscow or Kiev.

Tunnelling apparently started around 1965, and continued on and off until 1972. The first part of just two lines, which do not connect, opened in September 1973. Some maps show planned extensions at the end of each line, but given the current state of the economy these seem unlikely to come into operation for a long time.

Puhung station entrance. Photo John Smiles

Yonggwang station

The Red Line

Each station has long escalators down from the surface building; at Puhung station on the Red Line, for example, it took us three minutes to reach the platforms, believed to be about 110 metres below street level.

Foreign visitors are not normally provided with a ticket, but I asked for one, as a souvenir, and was given a tiny piece of card printed in light blue on one side and measuring 4cm by 2cm. Its value was five won, the equivalent of about two pence. There are entry barriers similar to those in London, but they appeared not to be operational on our visit.

Air-raid shelters

Each station has an individual architectural style, with designs, vast murals and lighting to match the name of the station or its symbol: Puhung (rehabilitation), Yonggwang (glory), Sungri (victory), Kwangbok (liberation), Hwanggumbol (golden fields) and so on.

The ceiling lights in Yonggwang station, for example, are intended to resemble the fireworks display of victory celebrations after the Korean war, while the chandeliers at Hwanggumbol station take the shape of bunches of

Typical Station mural (Puhung station)
Photo John Smiles

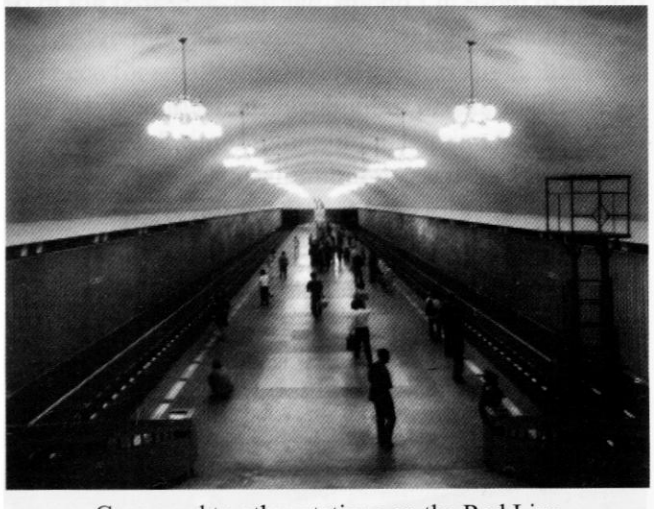
grapes in a bumper harvest. In each case the effect is remarkably realistic. As in Moscow and Kiev each station was built to serve as an air-raid shelter in times of war, although this is denied.

Most of the station platforms have grandiose architecture, with granite walls, marble columns and pillars, huge chandeliers and giant murals in the Socialist Realism style up to thirty metres long and 3.5 metres high. Some feature the Great Leader with happy workers and ancient tractors; others feature mountains and lakes, industrial scenes or river views. One splendid mural in Kwangbok station, entitled *Lake Samji in Spring,* runs the length of the platform, seventy metres long and four metres high.

German graffiti

Until recently visitors were allowed to ride only one stop on the Metro, between Puhung and Yonggwang stations on the Red Line. For the moment however the atmosphere is more relaxed and we were allowed to ride five stops from Puhung, meaning that we were able to see the platforms at six stations, and get off at three of them.

We rode in carriages crowded with local people, putting to rest the oft-repeated myth that other passengers seen by tourists on the Pyongyang Metro were simply actors placed there to look good and keep quiet. As everywhere else in DPRK, the platforms carried no advertising and portraits of the two deceased great leaders looked down on passengers in each carriage. Shades of *1984*. Sharp-eyed visitors spotted the vestiges of German graffiti scratched on the windows.



Compared to other stations on the Red Line the decor at Kaeson station is bland

Exiting at Kaeson ("triumph") station, we were not surprised to find ourselves facing the gigantic and inelegant Arch of Triumph, built in 1982 to celebrate Kim Il Sung's glorious return after defeating the Japanese in 1945, and purposely designed to be grander than its more famous namesake in the French capital. Made of 10,500 granite blocks, it is 60 metres in height and 52 metres wide. I prefer the one in Paris.

Driving on the right

The Metro's standard-gauge rolling stock is ancient and not particularly comfortable; most of it seems to be very old stock from East and West Berlin. The system 'drives on the right' using a 'third-rail' system, and operates similar hours to the London Underground, but with less frequency.

On some platforms we saw sheets of newspaper displayed behind Perspex; these were information boards so that passengers had access to the regime's latest news and propaganda while they were waiting. We were told that this facility is provided at all stations.

Inside one of the ageing metro cars

Busy stations had a smart young woman dispatcher on the platform, in uniform with an armband; her job was to hold a disc aloft as a signal to the driver when it was safe to depart. I don't remember whether there were any announcements.

The Green Line

The second line runs in a rough east–west direction between Kwangbok ("independence") and Ragwon ("paradise") stations – we asked our guide if we could take a ride on it but we were told this was not possible. However, on several occasions we passed close to the two end stations of the Green Line while on the road, and we noticed that there were no passengers in the vicinity; the buildings seemed disused.

Suggestions that the line was not actually operational were met with denial, but we have our doubts. The capital is known to suffer from electricity shortages from time to time, in addition to lack of spare parts in the event of a major breakdown.

The Metro Museum

Visitors are not normally taken to the Metro Museum, a vast half-empty two-storey building with no heating close to the Arch of Triumph. Not knowing what it comprised, our group made a special request to look round but the visit was a disappointment and we afterwards wished we hadn't!

The museum relates solely to the construction of the Metro, rather than its history and current operation. As such, like all government buildings, its main – some would say sole – purpose is to glorify and magnify the

Discounted Cotswold Shopping

Cotswold Outdoor have granted Sub Brit members a 15% discount on their products (excluding sales and special offers). The details are included in a letter on the website at

www.subbrit.org.uk/docs/discount-cotswold-outdoor.pdf

If you are not able to access the website, then please contact us with an SAE for a copy of the letter.

The discount code can be used in any of their 58 stores (there is a barcode on the letter), and for telephone and online orders.

**** Please do not share or abuse the code as this may lead Cotswold to withdraw it which would be a great shame and spoil things for the rest of our members. ****

Here is an introduction from David Hague of Cotswold:

"Cotswold Outdoor are proud to be a supporter of such a prestigious organisation as Sub Brit. As most of your members are aware, Cotswold Outdoor is a multi-award winning retailer with numerous thriving stores located nationwide. Not only are we proud of our knowledgeable staff, but our stores stock one of the most comprehensive ranges of outdoor clothing and equipment in the UK. With a huge range of footwear, waterproof jackets and fleeces, tents, sleeping bags and outdoor accessories, we offer one of the best selections of clothing and equipment right on your doorstep.

Whoever you are and whatever you need, when you shop with us you can be assured of expert, award-winning service and advice that comes from 40 years of experience in retailing. We're really looking forward to welcoming you to our store, online or over the phone soon. I hope that our discount helps your members purchase the right kit and equipment as they continue with their important and valued pastime. We are passionate about giving the right advice and recommending the right clothing and equipment so you can have peace of mind while out in (or should that be under!) the field."

achievements and exploits of President Kim Il Sung, who is seen in countless black-and-white photographs giving On-the-spot Guidance to miners, engineers, designers, electricians, concrete mixers and lavatory attendants (I made that last one up).

We were shepherded past various boring models and tableaux relating to the digging of tunnels and escalator shafts; it appears there are no lifts anywhere in the system. Questions to the official guide (interpreted by our own guide/minder) about depth of construction, cost, time taken, water table, tunnelling conditions, foundations of tall surface buildings and so on were all batted away without realistic answers.

Metro Ticket (enlarged)

You won't be surprised to learn (we weren't) that all the station names were chosen by the Great Leader himself, and that at the grand opening ceremony on 5 September 1973 he gave out medals, wristwatches and shirts to the heroic workers as gifts from him personally.

On-the-spot Guidance

Every time we reached a building, hotel, shop, museum, university faculty, exhibition, film studio, art school, hospital, farm, factory, orphanage, station or stamp shop, we were told that President Kim Il Sung or his son Kim Jong Il – often both – had made an official visit, sometimes more than once, and dispensed On-the-spot Guidance to directors and staff, engineers, doctors, nurses, teachers, hoteliers, botanists, agronomists, miners, printers, artists, sculptors, embroiderers, shop assistants and so on, this being the reason for that organisation's eminence and prosperity.

Each visit was commemorated by displays of innumerable photographs and a plaque or two above the door. How lucky they are to have such amazing polymaths in charge! On-the-spot Guidance is clearly something to be admired and is no doubt the key to North Korea's economic success.

More information at unofficial site
www.pyongyang-metro.com/